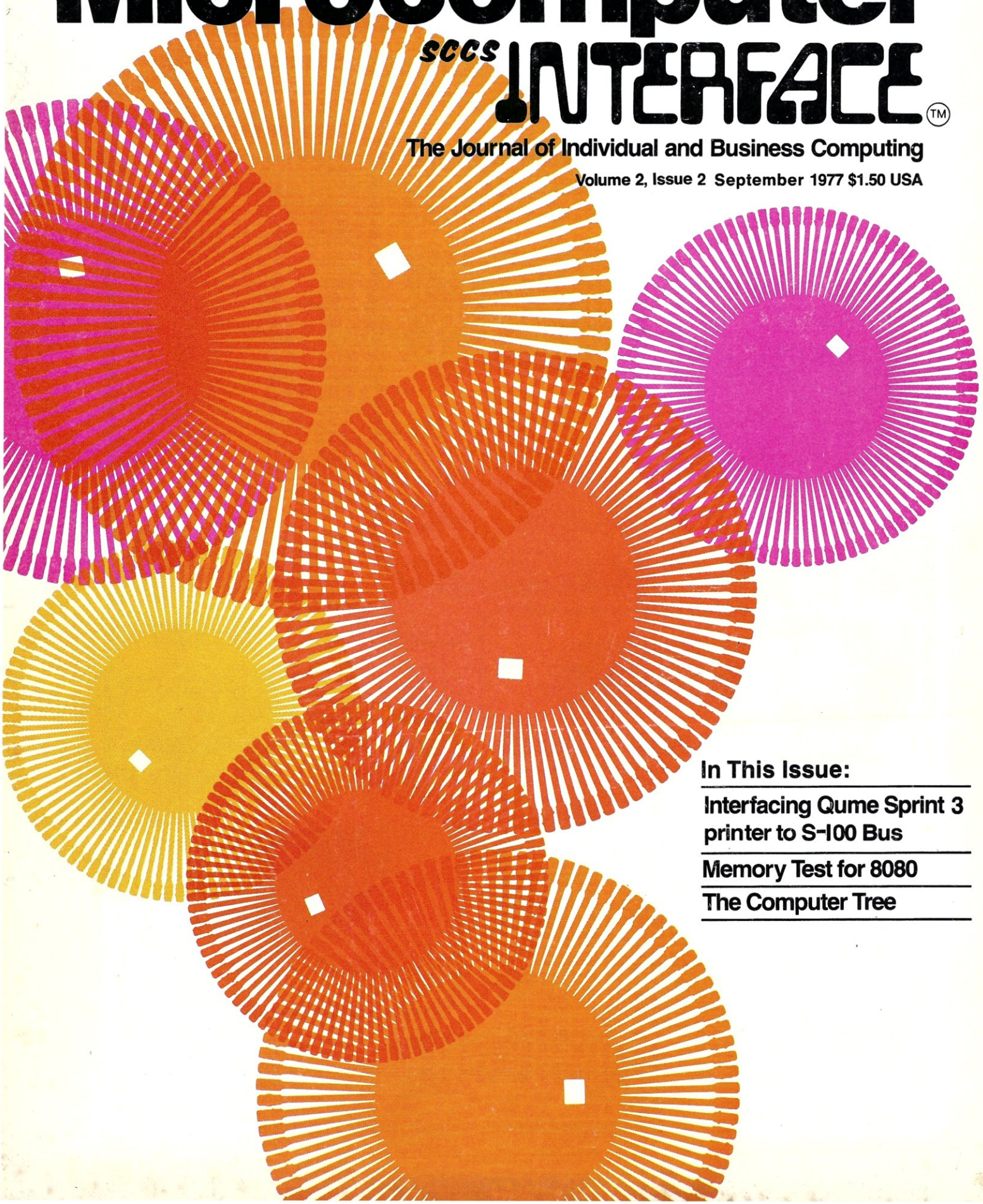
The Official Publication of the International Computer Society (SCCS)

Microcomputer

SCCS INTERFACE™

The Journal of Individual and Business Computing

Volume 2, Issue 2 September 1977 $1.50 USA



In This Issue:

Interfacing Qume Sprint 3 printer to S-100 Bus

Memory Test for 8080

The Computer Tree

From Parts to Peripherals:
a one stop, mail-order computer store, serving computer enthusiasts since 1973.

Vector VP2 Assembled Microcomputer Case

This adjustable packaging system for S-100 buss microcomputers is compatible with Altair 8800 and IMSAI 8080 size cards. Outside, it is beautiful...with a dark blue textured vinyl finish and lines unmarred by external screws or fasteners. Inside, there is space for 21 cards total (on 0.75" centers) with a fully adjustable interior card mounting system (card guides and hardware provided for 12 cards). The interior is instantly accessible, the rear and front panels are removable and recessed. If you want a classy home for your micro, check this out...it is the best we have seen.

VP2 ASSEMBLED MICROCOMPUTER CASE....$134.30

CRYSTALS

STATEK 3 TERMINAL CRYSTALS.....$4.95 each (all frequencies in KHz)

10.000	12.800	15.360	16.000	16.384
18.641	19.200	20.480	24.576	30.720
31.500	32.768	36.864	38.400	40.960
60.000	76.800	100.00	153.60	240.00

SENTRY CRYSTALS: SERIES MODE, FUNDAMENTAL, WIRE LEADS, HC18 PACKAGE.....$4.95 each (all frequencies in MHz)

4.0	4.5315	5.0	8.0	9.0
10.0	12.0	15.0	18.0	20.0

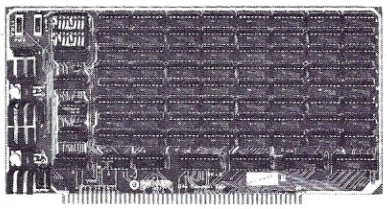
MISCELLANEOUS CRYSTALS

500 KHz, series mode, fundamental, HC6/U package, wire leads.....$4.95 **each**

1 MHz, series mode, fundamental, wire leads in HC6/U package.....$5.95 **each**

2 MHz, series mode, fundamental, wire leads in HC6/U package.....$5.90 **each**

8Kx8 Econoram II™
single kit $163.84
3 kits-24K!-$450



Those who know memory recognize the Godbout board as not just an exceptional value (it's no secret we know how to keep costs down), but as an example of how to pack extra options into a basic memory board. Extras like a vector interrupt provision if you try to write into protected memory. Configuration as **two** independent 4K blocks (both protectable separately). A selectable write strobe for either PWR or MWRITE. An all static design, free of timing and refresh problems. Guaranteed speed under 450 ns (with on-board wait state logic for use with 4 MHz Z-80) and guaranteed current under 1.5A (1250 mA typ). And of course...sockets for all ICs, legended board with solder mask, one year warranty on parts...**we've got it all.**

ALSO AVAILABLE: 8K ASSEMBLED, TESTED, WARRANTED 1 YEAR...$188.50; 4K KIT...$100.

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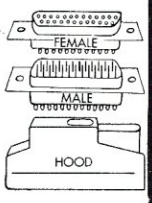
74LS01	0.30	74LS155	1.38
74LS02	0.30	74LS157	0.95
74LS04	0.33	74LS160	1.40
74LS08	0.36	74LS161	1.40
74LS10	0.30	74LS162	1.40
74LS11	0.36	74LS163	1.40
74LS12	0.33	74LS168	1.87
74LS14	1.38	74LS169	1.87
74LS15	0.30	74LS173	1.65
74LS20	0.30	74LS174	1.25
74LS21	0.33	74LS175	1.15
74LS22	0.33	74LS195	1.30
74LS26	0.43	74LS240	1.88
74LS27	0.36	74LS257	1.25
74LS30	0.30	74LS258	1.25
74LS32	0.38	74LS266	0.53
74LS37	0.45	74LS283	1.20
74LS38	0.45	74LS365/	
74LS42	0.98	80LS95	0.75
74LS47	1.00	74LS366/	
74LS48	0.98	80LS96	0.75
74LS74	0.50	74LS367/	
74LS75	0.68	80LS97	0.75
74LS76	0.50	74LS368/	
74LS86	0.50	80LS98	0.75
74LS109	0.50	74LS386	0.55
74LS125	0.63	81LS95	1.13
74LS126	0.63	81LS96	1.13
74LS132	1.25	81LS97	1.13
74LS138	1.10	81LS98	1.13
74LS139	1.15		

CAVE graphx™

25 PIN RS-232 CONNECTORS: sub-mini D type.



Male plug with plastic hood, part #DB25P $3.95

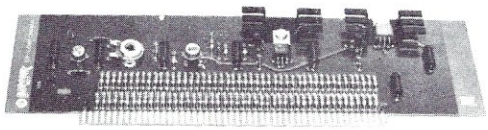
Female jack, part #DB25S $3.95

DB-25 CONNECTOR

EDGE CONNECTORS: #S-100-140ST Gold plated soldertail edge connector, 0.140" spacing for Altair Motherboards....**1/$6, 5/$27.50**

#S-100ST same but .250" row spacing for IMSAI.....**1/$5, 5/$22.00**

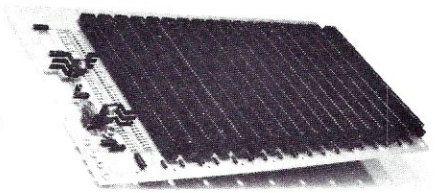
#S-100WW same but gold plated, 3 level wrap posts..**1/$5, 5/$22.00**



Active Terminator $29.50

Plugs into any S-100 Motherboard whose buss lacks active terminations. Cleans up noise, crosstalk, overshoot, and other buss problems that can scramble data unpredictably. Kit form only.

MOTHERBOARD
10 Slots $90 18 Slots $124



Includes **all** edge connectors, plus active terminations to minimize crosstalk, noise, overshoot, and ringing that may be present with unterminated busses. Excellent for stand alone system, or add to existing systems. Kit form only.

Music spoken here

Many of you are into making music with your computer; some people generate sounds within the machine itself, others use them to control synthesizer hardware. Where do we come in? One of our lines is the series of Musi-Kits™ designed by Craig Anderton, writer for Guitar Player, Popular Electronics, Contemporary Keyboard, and a bunch of others. MusiKits™ contain a circuit board, electronic components, and pots; user supplies case and hardware. There are 24 in all...some you might like are the **8 In, 1 Out Mixer (#18, $20)** which can mix up to 8 audio inputs to a common output; the **Super Tone Control (#17, $10.50)**, a low noise, state variable filter that gives high, low, and bandpass outputs; a **Reverb Unit (#22, $13.00** less springs) for adding concert hall sound and acoustic depth. Want to know more? Check our flyer.

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10000 uF at 10V!

Building a 5V power supply? Need to beef up an existing supply that lacks sufficient capacitance? Here is the answer.

TERMS: Please allow up to 5% for shipping, more for Vector #VP2; excess refunded. Prices good through end of magazine cover month. Californians add tax. CODs accepted with street address. For BankAmericard®/VISA®/Mastercharge® orders ($15 min) call **415-562-0636**, 24 hours.

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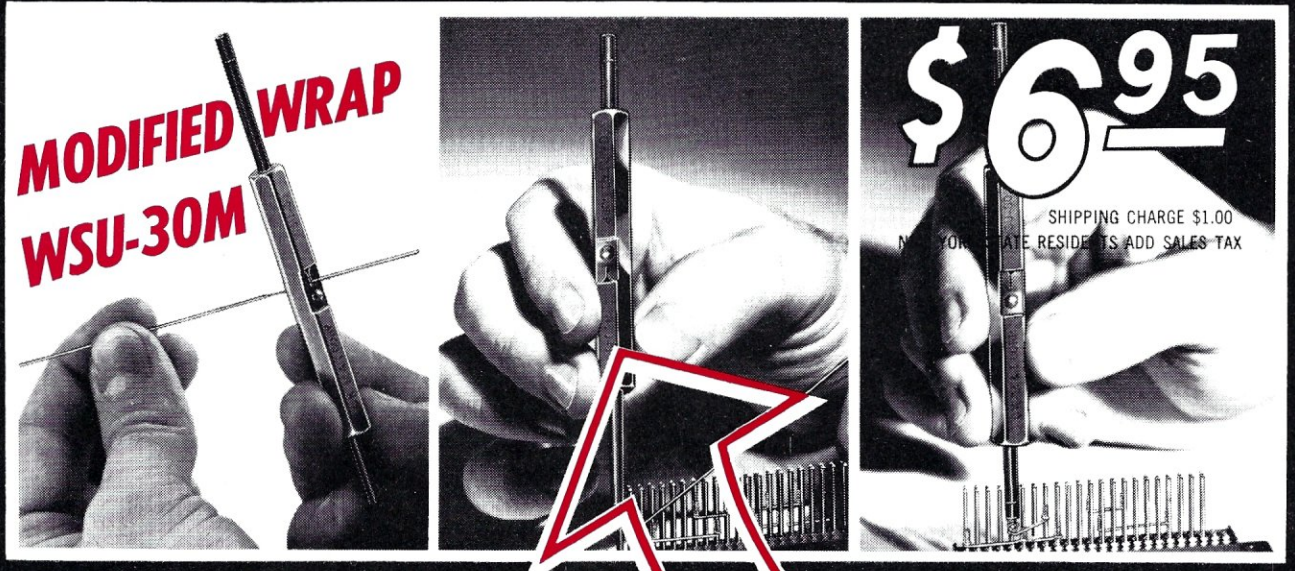
SEVERAL GOOD REASONS WHY YOU SHOULD HAVE OUR FLYER: 1) CMOS 2) LINEARS 3) MICROPROCESSORS 4) POWER SUPPLIES 5) RESISTORS 6) CAPACITORS 7) DISPLAYS 8) SOCKETS 9) VECTOR PRODUCTS 10) ENCLOSURES 11) ALL THE OTHER THINGS WE CAN'T FIT INTO THIS SPACE.

Circle Number 50 on Reader Service Card

HOBBY-WRAP® WIRE-WRAPPING, STRIPPING, UNWRAPPING TOOL FOR AWG 30 (.025 SQUARE POST)



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PART No. WSU-30

TYPES OF WRAP

■ A "Regular" bit wraps the bare wire around the terminal. A "Modified" bit wraps a portion of insulation around the terminal in addition to the bare wire. This greatly increases the ability to withstand vibration.

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TELEX: 125091 TELEX: 232395

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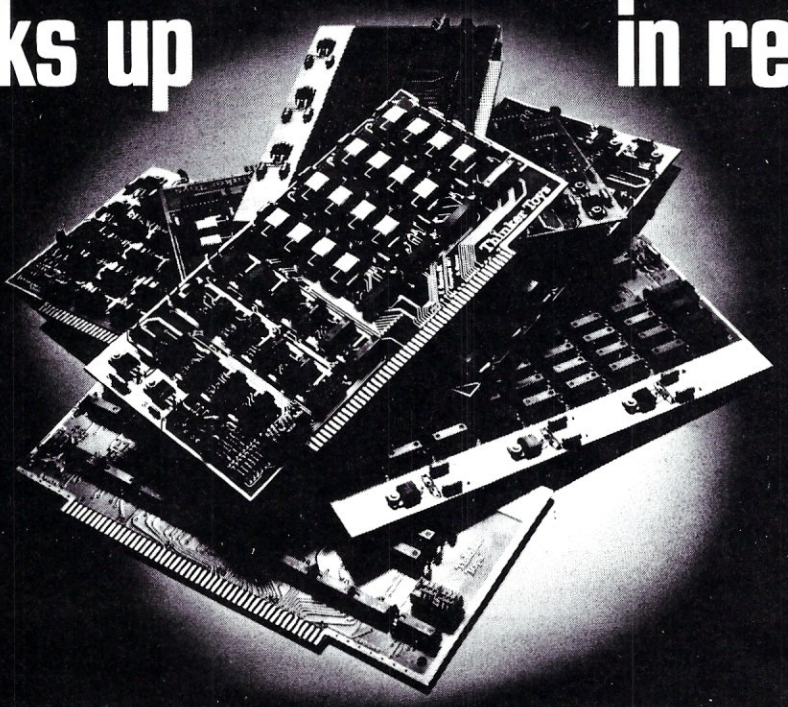
Now low-cost memory stacks up in reliability!



Introducing a new generation of ECONORAM* dynamics with SynchroFresh™ reliability

Meet ECONORAM* III with SynchroFresh™, the 8Kx8 dynamic memory for S-100 bus computers that really works. And uses less than half the power of static designs. And costs just $149 for an assembled 8K.

Unlike previous attempts at building a low-cost dynamic memory, ECONORAM* III is entirely reliable ... because of SynchroFresh™, a new approach to memory refresh that is simple, elegant and totally effective.

SynchroFresh™ was invented by George Morrow, designer of the original ECONORAM*. Instead of arbitrarily interrupting your CPU to perform memory refresh cycles, Morrow designed SynchroFresh™ to weave refresh invisibly into the natural timing of the S-100 bus. SynchroFresh™ circuitry simply monitors your computer's machine states, utilizing all of the normal opportunities for memory refresh. It's that simple.

And simplicity means reliability and dramatically lower cost. That's why a SynchroFresh™ design was chosen for the first ECONORAM* dynamic, to follow in the footsteps of the largest-selling static memories for personal computers.

ECONORAM* III with SynchroFresh™ is an 8Kx8 dynamic board, configured as two individually addressable 4K blocks for flexibility. It is available assembled, tested and warranteed for one full year for just $149. This unprecedented warrantee offers a full refund of purchase price if ECONORAM* III does not run reliably with your S-100 CPU—evidence of our confidence in its performance.

It is also available as a kit with complete assembly instructions and documentation for $159.

ECONORAM* III with SynchroFresh™, in assembled or kit form, may be ordered directly from Thinker-Toys™. Write 1201 10th Street, Berkeley CA 94710 or call (415) 527-7548. Call BAC/MC orders toll-free to 800-648-5311. Or ask your computer store to order it for you.

NEW LOW PRICE

$149

8K assembled, tested, warranteed
1 year

A product of Morrow's Micro-Stuff for

Thinker Toys™

*ECONORAM is a trademark of Godbout Electronics.

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The official publication of the International Computer Society (SCCS)

Microcomputer SCCS INTERFACE

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Direct all Society correspondence to:
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Tom Woodward

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Phil C. deBaca (213) 644-4658

Direct all editorial, advertising and production correspondence to:
1415 Second Street, Santa Monica, CA 90401

Editors and Coordinators

Bob Allbrecht	Phil Feldman	Bill Sinclair
Phil C. deBaca	Lou Fields	Don Tarbell
Kay C. deBaca	Jim Levin	Lew Whittaker
Jim Carlstedt	Frank McCoy	Tricia Wood
Ron Carlson	Larry Press	Nancy Woodward
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Advertising Representatives:

West:
Brent H. Salmon and
Ron Thorstenson
Western Media Sales
5353 Topanga Canyon
Woodland Hills, CA 91364
(213) 888-0284

East:
Ralph Miller, Bob Nelson,
and John Pearsall
Nelson & Miller Associates, Inc.
342 Madison Ave, Suite 830
New York, N.Y., 10017
(212) 661-9234

Midwest:
Lyle D. Hurd, Jr., and
Katherine Hurd
Lyle Hurd and Associates
333 N. Michigan Ave., Suite 1818
Chicago, Illinois 60601
(312) 726-6464

Southwest:
Carl Grisham
Business Publications
Representatives, Inc.
7110 Oakland Avenue
St. Louis, Missouri 63117
(314) 647-7667

South:
Jack Narvell
Narvell & Crank Associates, Inc.
Suite 102, 3110 Maple Dr. NE
Atlanta, Georgia 30305
(404) 261-0436

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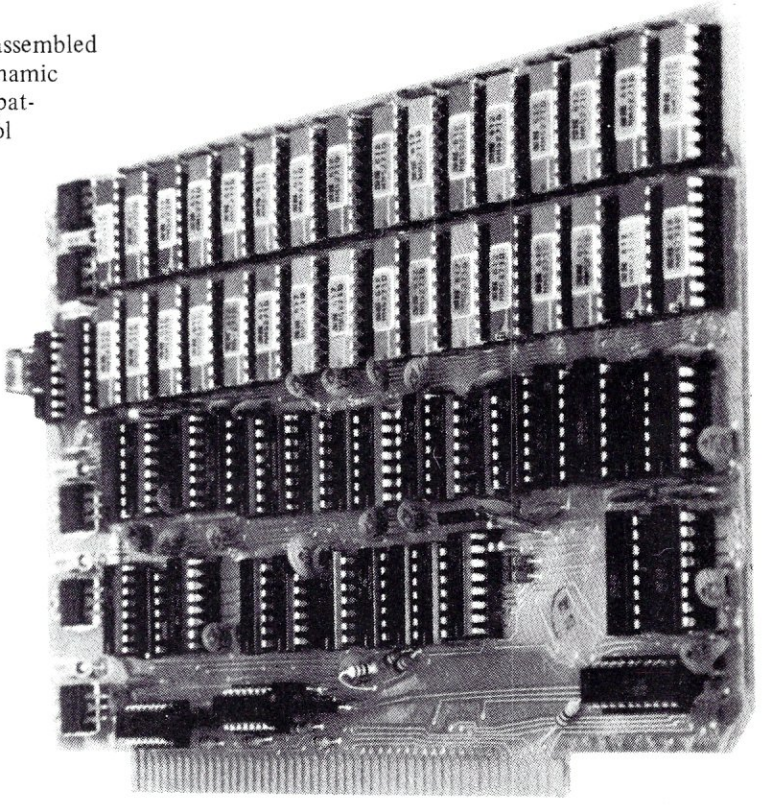
16384 BYTES for $485.00

assembled (with sockets) : tested - burned-in - guaranteed

A new high in S100 bus memory cost effectiveness. Fully assembled (with sockets), tested, burned-in and guaranteed. 4Kx1 dynamic memory chips (the same ones used by the ton in IBM compatible memory systems) combined with self contained control logic, yield a memory system with these features:

- Low power consumption, total board 5 watts.
- Transparent refresh, which means the memory looks static to the outside world.
- No waiting. In fact, XRDY is not even connected to the memory.
- Full DMA capability.
- Reliable, low level clock and control signals.
- Three full days testing at 70° C (185° F).



SPECIFICATIONS

Capacity:	16384 bytes
Addressing:	16K boundaries
Bus structure:	S100 - Plug compatible with IMSAI 8080, POLY 88, ALTAIR 8800, BYTE-8, SOL
Address and Data Buffering:	<200 uA, special high impedance buffers - less than one low power Schottky load
Access time:	350 nSec
Memory chips:	MM 5271 (National Semiconductor and others) 4K dynamic

Dynabyte Inc.

4020 Fabian Way, Palo Alto Ca. 94303

for more information call or write to:

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2233 El Camino Real
Palo Alto, California 94306
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Dynabyte® brings to the S100 Bus a state of the art, industrial quality memory system. 16K on a single board for $485.00, Guaranteed for 1 year.

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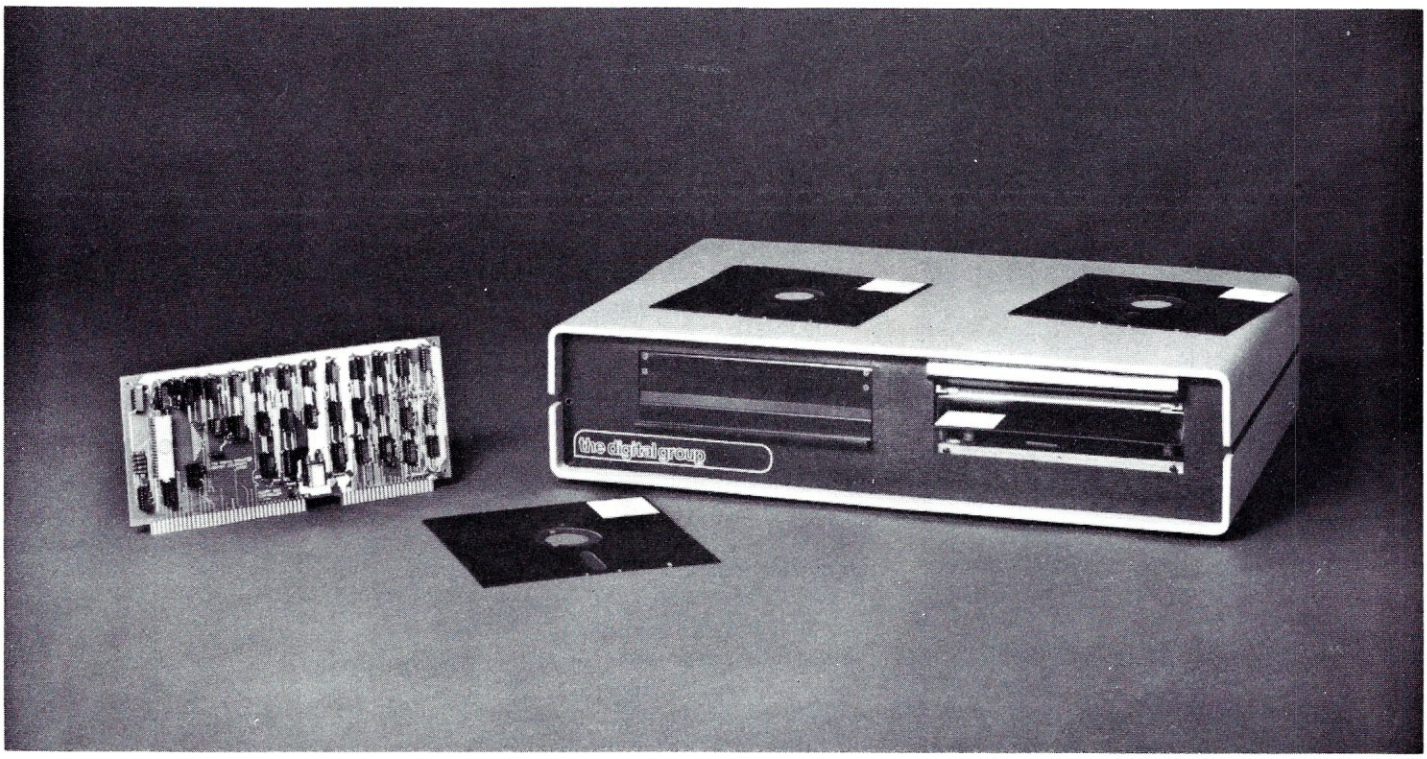
NOW, DISKS TOO!



(And they're **Disk**-tinctly Digital Group.)

With the addition of our all-new Disk Subsystem, the Digital Group becomes the only manufacturer of microprocessors to offer you a real choice. Tape or disk. Or both. Whatever *you* want.

We spent a lot of time designing and testing our new Disk Subsystem, and it shows in the result. The Subsystem is highly flexible. . . gives you direct access to data. . . and completes your Digital Group System.

Here's what the Disk Subsystem consists of:

Disk Interface Card--provides the electrical interface between the disk drives and the computer.

Disk Power Supply--provides all power required for up to 2 drives.

Disk Cabinet and Cables--cabinets provide housing for 1 to 2 drives plus the power supply; assembled cabling is provided for connection between all system components.

Disk Drives--the Digital Group Disk Subsystem supports standard 8" floppy disk drives from a number of manufacturers. Drives can be mixed, and in addition, mini-floppy drives are available for the function of a disk at minimum cost.

Documentation and Software--the Digital Group's standard documentation includes construction guides, maintenance manual, theory of operation and other useful information to help you get the fullest value from your new Disk Subsystem. And there's also software to provide initial support.

The price? Low. It's become a tradition with the Digital Group to offer you high-quality, state-of-the-art equipment at the lowest possible prices. Our new Disk Subsystem is no exception.

For only $745, you can get a standard 8" floppy drive and an interface card. A complete single-drive Disk Subsystem with interface, power supply, cabinet, and cables is as low as $995.

Now the Digital Group system is really complete. If you don't own it all yet, take another longing look. In addition to our CPU, keyboard and video monitor, you can add an impact printer and the cassette storage system. All in our beautifully coordinated custom cabinets. All unmistakably Digital Group.

The Digital Group now has disks. And a lot more. Why not find out about all of our exciting products? Simply call or write today for direct information. From the Digital Group.

the digital group

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President's Message

Scientific American

You are all encouraged to read the September, 1977, issue of *Scientific American*. At long last, this fine, prestigious publication has recognized our field with a cover story on microelectronics. Of particular interest is the article on personal computing. Though the principle emphasis is toward children and education, the article raises some very interesting questions. As it points out, it is sad to note that the great and obvious application of motion pictures and television to education has also not been realized. Let's hope microcomputers have better success.

I have been continually surprised that these machines have not also seen more immediate popularity for word processing (as with the COMPAL system).

Wide participation

I call on all of you to nominate candidates for officers, directors, and committeemen. See page 7.

We hope to have widespread, active, and enthusiastic participation. A technical advisory board consisting of chapter chairmen, heads of other societies, manufacturers, and schools has been suggested. Let me know of your interest.

Fast Feedback

We very much need your input via the magazine's reader service cards. This helps us to better meet your interests.

Since our last issue, even more, new, small, low-cost machines have been announced. And with their time-share capabilities for Altair 100 bus systems, as one form of competition, we have an even more increasing choice. Please let us know what you feel about this.

Memories Are Made Of . . .

New high-speed CPU and logic circuits are now being sold of "silicon on sapphire." Diamonds are also being tested for semi-conductor use. Garnet helps make magnetic bubble memories. These seem close to offering a practical, "solid-state magnetic disk," and are a particularly good memory for such tasks as word processing. We are close to seeing these gems worth more as tool material than as jewelry.

The remaining major component needing improvement, the printer, is close to solution. The Matsushita ink jet facsimile recorder is an exciting possibility. If we all show interest, perhaps they will see a significant enough market to supply it.

I again urge all clubs to submit copies of their publications for exchange subscriptions.

Respectfully submitted,

Louis G. Fields,
President

Fast Feedback

Letters

Needs Help!

Gentlemen:

I have been reading about computer hobbyists in the States in a French electronic magazine.

I'm interested in electronic music and want to build a synthesizer with a μProcessor (microprocessor). I have heard that people can buy affordable "up" in the States, in computer hobby shops; I will be glad if you send addresses of such shops. I am also looking for microprograms ready to use in electronic music.

Being a foreigner, I don't know if I can be a member of your society, I'm already an AES member, I will be pleased to receive an example of "Interface," even a back issue with your admission instructions.

Awaiting your answer,

Sincerely yours,

Marc Vezon
21 Rue du Bocage
F92310 SEVRES FRANCE

Compucolor Group Formed

Dear Sirs,

A group of us have gotten together to form a Compucolor users group. This group is dedicated to the exchange of programs and technical data for the Compucolor. We anticipate issueing a news bulletin periodically. Subjects such as how to concatenate tapes and disks will be covered. For each accepted program a member will receive in return a number of other programs. There will be an initial membership fee of $10.00. This is to cover the duplication and mailing of materials. Those wishing to join the group may send the fee to S. P. Electronics at 5250 Van Nuys Blvd., Van Nuys, California 91401. Further information may be obtained by sending a large self-addressed envelope to this address. Among our present programs are illustrated versions of Blackjack—A Right Rectification Program—A fantastically illustrated version of Star Trec—Illustrated Slot Machines—Etc. For the most part we will try to exchange recorded media rather than program listings. Anyone interested is welcome to drop us a line.

Stan Pro
S. P. Electronics
5250 Van Nuys Blvd.
Van Nuys, Cal. 91401

Society News

Start an ICS Chapter

If you would like to start a chapter of the International Computer Society, apply by submitting a petition for official appointment to:

President
International Computer
Society/SCCS
Box 49707
Los Angeles, CA 90049

The petition should include:

The name of the group
The names of the officers:
Chairman
Secretary
Treasurer
(or other responsible persons)
The names, addresses and phone numbers of ten current or new ICS/SCCS Members

Anyone wishing to form a chapter may publish a notice in *Microcomputer Interface*.

Nominations for ICS/SCCS Elections

Please submit your nominations including qualifications, for officers (President, Vice-President, Secretary, and Treasurer) and directors no later than October 15, 1977, to

ICS/SCCS Nominations Committee
c/o Ken Widelitz
10960 Wilshire Blvd. #1504
Los Angeles, CA 90024

Or use Fast Feedback postcard.

Editorial

Beginning with this issue, we are trying a new editorial approach—we are decentralizing the editorial responsibilities. Each associate editor, columnist, and department coordinator will have more responsibility. We hope this will allow for more variety and will eventually result in a more diversified and exciting publication. And it takes the burden off one person; we need more participation from the members. If you will contact the department coordinators with your contributions and ideas, you can have a voice in the growth of ICS/SCCS and the magazine.

Larry Press, who has worked as Editor-in-Chief (and most of the Indians) for the past five issues, has the responsibility for **"Applications Exchange"** and for coordinating editorial mail and for deadlines. Larry, VP of ICS/SCCS, has worked in computing since 1960 and is a consultant and teacher.

Lou Fields, President of ICS/SCCS is a **contributing editor.** He is an inventor and holds patents in the fields of optics, hydraulics, chemical measurements, psychological test measurements, and pneumatics. He is currently a consultant in medical and scientific research and in computer design and applications. He plans a series of personal profiles. Appearing next month will be the first of a three-part interview with Paul Allen, vice-president of Microsoft and co-author with Bill Gates of a BASIC interpreter for the Altair and the Pet.

Phil C. deBaca, ICS/SCCS Treasurer and General Manager and member of the board of directors, and his wife Kay supervise the Society mailings and handle the updating of the mailing list. Organizing the list has proven to be a herculean task but Kay is making progress and soon we expect to have all of the snarls untangled.

They also coordinate **circulation and distribution** to libraries, clubs, and stores. With the expanding interest in individual computing, the computer store and the regional computer club are the focal points for the computer enthusiast. The International Computer Society supplements this by providing international communications. Stores and clubs should contact Phil if they are interested in distributing "Microcomputer Interface".

Phil is also an editorial contributor. He has a background in technical writing and computer technology. He reviews our technical articles as well as most of the programs.

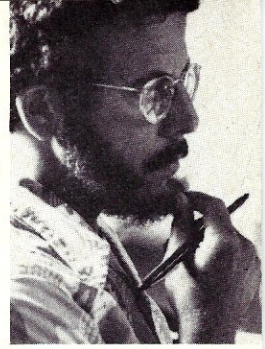
Ron Carlson, past member of ICS/SCCS board of directors, is an associate editor and writes the reviews column, **"Reviews, Pointers 'n' Such".** He is with UCLA and is extremely competent in both hardware and software. He knows the Mark-8 better than anyone on earth and is our Mark-8 applications exchange coordinator. His rating code for books was introduced in the August issue and this innovation should be a great help to all of us.

Tom Rugg and **Phil Feldman** are associate editors and write the monthly column **"Games and Things".**

Tom Rugg is a Senior Technical Analyst at GTE Data Services in Marina del Rey. His functions include providing programming and debugging help for the programming staff as well as working on software conversions, and optimization efforts. Tom also has Explorer Scouts working with the GTEDS computers.

While Tom was getting his B.S. degree in Quantitative Methods from Cal State Northridge, he discovered that computers are fun. It's been over ten years, but he still feels that he's just beginning to discover all the things that can be done with them.

Phil Feldman has been tinkering with computers for about ten years. He received his B.A. in physics from the University of California Berkeley and a B.S. in astronomy from USC. Currently, he is doing graduate work in computer science at UCLA. He



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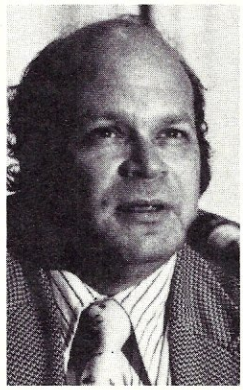

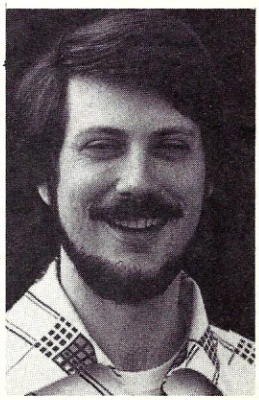

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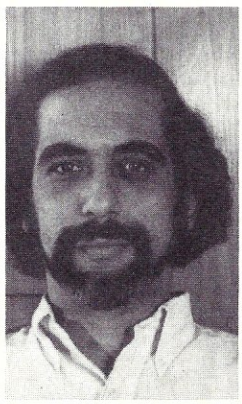
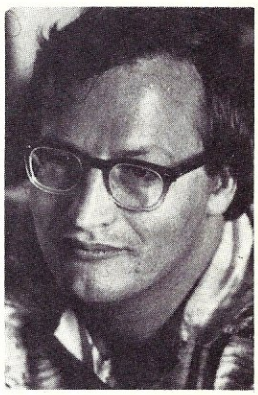
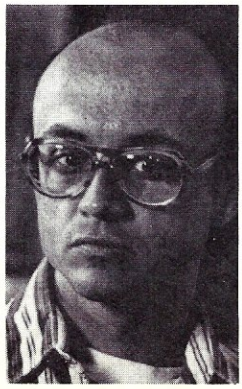
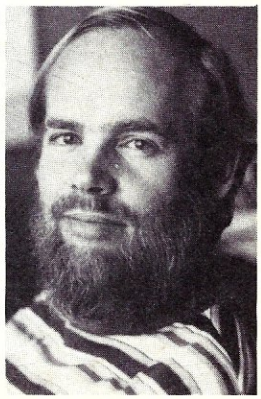




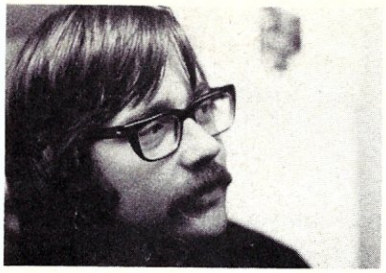




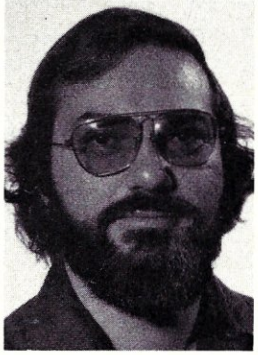
Jim Carlstedt

Roger Zimmerman

Jim Levin



Don Tarbell



Tricia Wood

Bill Sinclair

Lew Whitaker

Tom Woodward

Nancy Woodward

is employed by the Fluid Physics Laboratory of TRW Systems in Redondo Beach doing scientific programming and formulation of mathematical models of physical systems. This background and lifelong interest in recreational mathematics has naturally progressed to his co-editorship of "Games and Things."

Contributing editor **Frank McCoy** is an R & D engineer at Tape Athon. He says he has a "How to do it approach" to hardware and software problems. He wrote the memory test in this issue, "Memory Additions for the MITS 680" in July, and "Tiniest Trek" in February. Next month he will edit a new column **"Software Exchange"** as well as **"Reprints".** Frank sees an ICS library of software which members may exchange . . . details next month. He is interested in talking with anyone about interesting, de-bugged VTL II and Altair 680 and 8080 programs. Call him at home (213) 644-7395.

Roger Zimmerman is **"New Products"** editor. Roger is a graduate of the University of Wisconsin and has a MBA from UCLA. He is a charter member of ICS/SCCS.

Microcomputing is changing and growing at such a rate that new product releases are one of the most newsworthy columns in the magazine. Besides a state of the art review, Roger plans a section on "Things I'd Like to See" which will be a forum for the reader to air his ideas for new products and services.

Bob Allbrecht is an **associate editor.** Bob claims to be the world's first home computerist in that he had an LGP-30 at home in the late 1950's. He is responsible for starting all sorts of things like the first public access computer center, People's Computer Company, "Dr. Dobbs Journal," the DYMAX publications and the Great San Andreas Fault Caper. Bob has even worked for Control Data Corporation.

Jim Carlstedt and **Jim Levin** are an **associate editor team.** They are both members of the research staff at the Information Sciences Institute of the University of Southern California. They hope to narrow the gap which exists between the hobbyist and the computer scientist. They want to keep us from reinventing the wheel and keep us up to date on what is happening in their world. Carlstedt's specialty is operating systems and Levin's is models of cognitive processes. Jim Levin comes from UC at San Diego and Jim Carlstedt was at RAND and at SAAB in Sweden before coming to ISI.

Don Tarbell is an **associate editor.** Don is the designer, manufacturer, and purveyor of the Tarbell cassette interface. One of the founders of the society, the first meeting was held at Don's apartment complex in 1975. Don has a broad professional background and has indicated that, in spite of being a hardware manufacturer, he would like to contribute most heavily in the area of software.

The world is full of "software types" such as programmers, systems analysts, computer salesmen and even interested laymen, who would like to build or buy a computer; but are afraid of the hardware. **Tricia Wood** has been there. Two years later, with a lot of research, hard work, and help from her friends, she has a homebrew computer on the air. Tricia's series of articles **"Helpful Hints, or What I Had to Learn to Build a Computer"** helps others cover this ground more easily. If you've been reluctant to get a computer or if you are curious to know what is going on inside of your ALTAIR, but not exactly sure what to ask, you will be interested in Tricia's column.

Associate Editor **Lew Whitaker** is an ICS/SCCS member with a love of science fiction, which has resulted in **"Science Fiction Corner".** Lew has been in computing for a long time, beginning as a programmer at RAND. He's also an incurable entrepreneur. He has a coffee house, a commercial bakery and currently has a new company in the works.

Bill Sinclair is a computer professional at JPL. He organized the music symposium earlier this year and

reviewed it for our July issue. In addition to these significant contributions, Bill processes our **Reader Service Cards** and **Fast Feedback Poll.** Reader service card response is an index to reader interest in advertising and new products listings—they are a measure of how well the publication is doing for the advertisers. The decision of whether to advertise with us is sometimes based on how many inquiries an ad pulled. We encourage you to use this means of expressing interest in a product and getting more information from an advertiser.

Nancy Woodward, photo editor, is a professional photographer. (Since she also spells well, she reads proof too!) Nancy's photographic work will be appearing in the magazine and in the Audio-Visual Tutorials which are now being produced. We want to cover local chapter events and encourage chapters and local clubs to send us pictures, captions and write-ups of meetings and projects.

Richard Chew is coordinating the **Discount Purchasing Program.** The plan, outlined by Gene Murrow in the February issue was started in July and is working well with new vendors added in this issue.

Discount purchasing is a tangible membership benefit. Usually the yearly membership fee is saved on the first purchase. Retailers and manufacturers interested in participating should contact Richard through the magazine.

Tom Woodward, Publisher, is a graduate from Carnegie Mellon University. He's had his own graphics design office for 20 years. He produces audio-visual multi-media programs for NASA, Jet Propulsion Laboratory, The California Museum of Science and Industry, and others.

He originally joined ICS/SCCS to find help with applications in audio-visual programming and computerized techniques for doing sculpture but soon found himself knee deep in producing this magazine.

With this highly qualified group of editors, columnists and coordinators, we will be able to provide high level editorial content, useful services and society benefits. We still need help. Please get in touch with us if you can coordinate any of these departments:

Audio-visual library. A coordinator needs to gather a library of tapes, films, slide shows, video tapes from individuals, institutions and manufacturers. Meetings should be taped and audio-visual tutorials created.

Membership coordinators, perhaps by regions, so that we can more effectively reach others interested in microcomputing.

Speakers Bureau. Program planning for schools, computerfests, conferences and club meetings. This coordinator should prepare a list of subjects and speakers. We'll publish the listings.

Calendar Coordinator. A full up-to-date listing monthly of what's happening around the world in computing and electronics.

Classified Advertising Coordinator. This is another direct membership benefit. Free space to run personal classified ads. We see this swap meet as eventually being several pages long.

Society News Editor, to report on events and activities.

Clubs and Chapters Coordinator, to arrange for new chapters and to report on club and chapter activities.

Fast Feedback Coordinator. This is a potentially exciting form of communications where the readership is polled monthly on questions of interest to the Society and the industry. Results appear the following month.

Ombudsman Service Coordinator. We would like people who would be interested in helping in this vital area.

Standards and Product Evaluation Coordinators.

Associate Editors. For technical review, proofreading, rewriting. Frequently people with good ideas are reluctant to submit articles because they lack editorial polish. This department will unscramble sentences and syntax and make it all sound right.

We want to hear from you!

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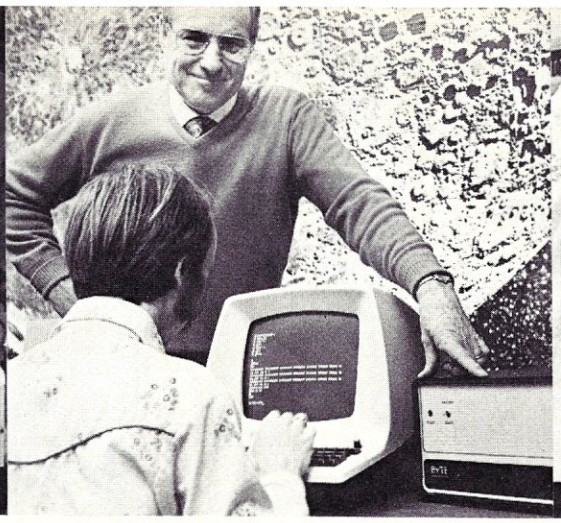
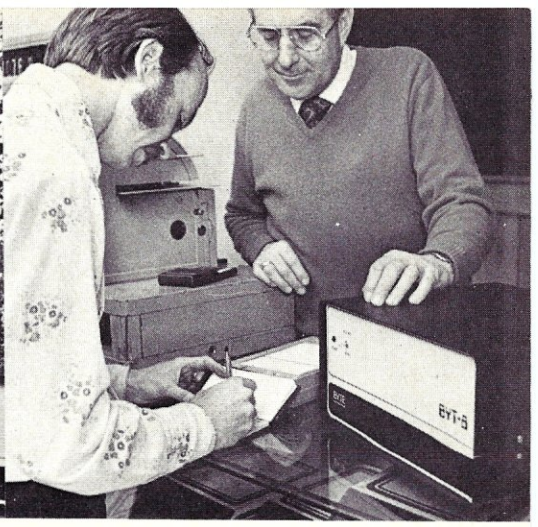

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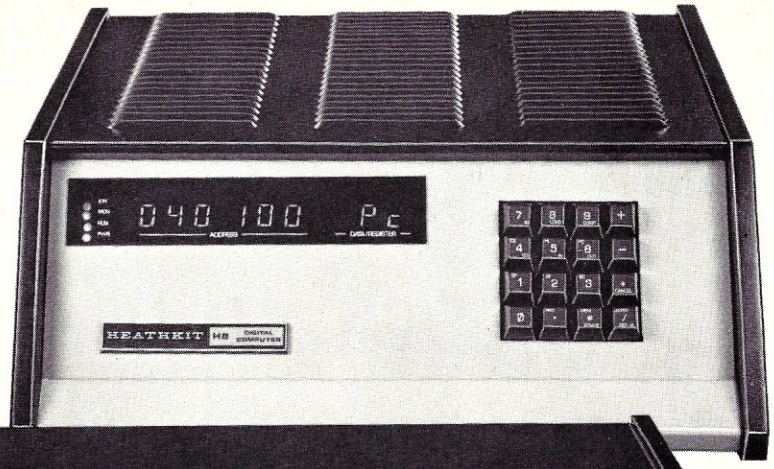

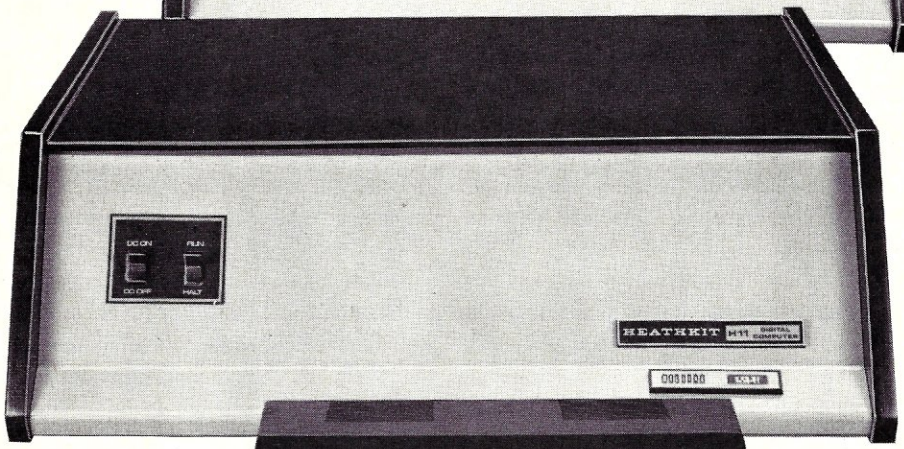

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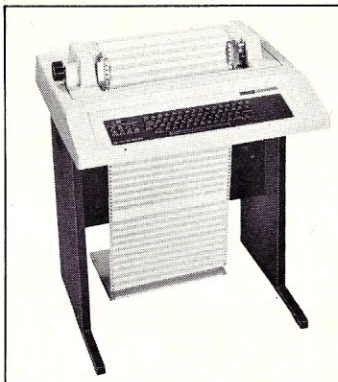

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Cover Story

Interfacing the Qume Sprint 3 printer to the S-100 Bus: It's much easier than I thought.

By Jef Raskin

Jef Raskin is a seasoned computer professional and Renaissance man. He is the product and software evaluator for "Dr. Dobb's Journal."

There I was, having proudly built and Altair 8800, an IMSAI 8080 and a whole pile of Poly 88's, and ennui was rapidly setting in. What I really wanted to do with my home system was to improve my quality of life—everyday life, not just the neat life game demonstration.

My friends still enjoyed matching wits with the simple games I programmed, and I was getting some use from my airfoil design programs (I run a company that designs model airplanes). But most of the time the computer was merely a conversation piece turned on when a calculation was needed or there were visitors to snow.

Wanted: A Hard-Copy Device

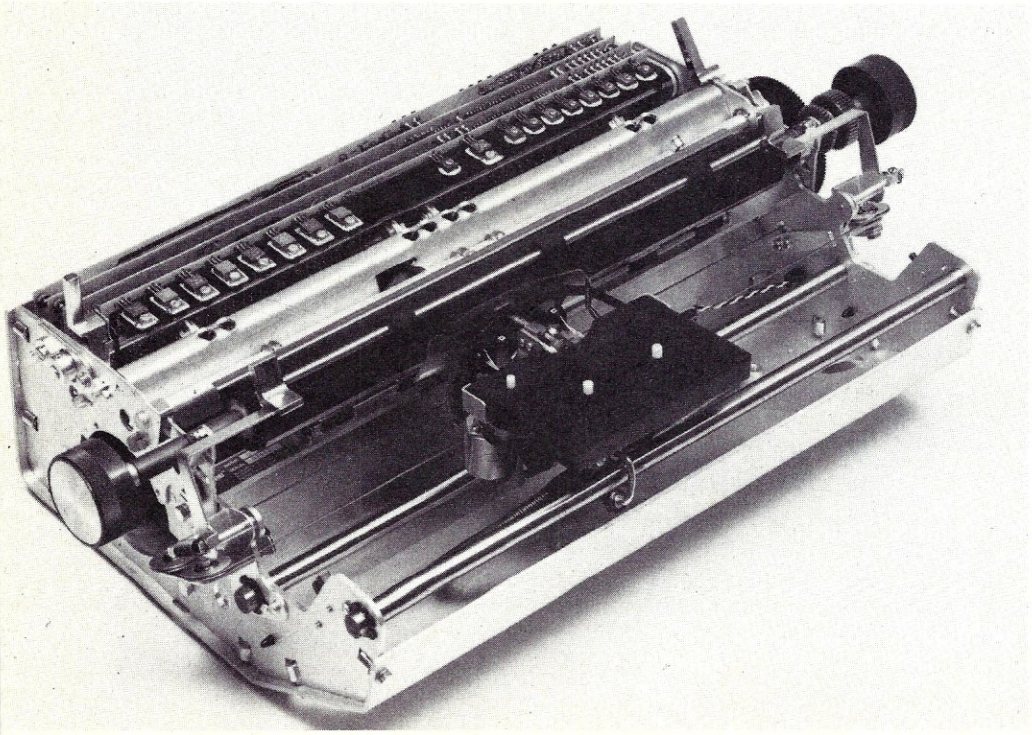
I already had plenty of memory, a reliable cassette for off-line storage, and all the I/O ports my heart could desire. I had a CRT terminal as well as a memory-mapped (Polymorphic Systems) TV driver. What I needed to make my system practical for accounting, letter writing, producing advertising copy, doing articles like this, and interchanging programs with others was a hard-copy device. For "hard copy" read "hard cash." They were either expensive or had truly crummy-looking output.

One way out of the dilemma was via the rash of IBM Selectric (TM) terminals and conversions. These had acceptable print quality, but after hearing the horror stories about attempted conversions at the Famous Homebrew Computer Club, I was leery. The Selectric-based terminals from the various manufacturers seemed to run about $1500, which was not bad (considering that nothing seemed cheaper); but they didn't use ASCII as the input code. They usually use EBCDIC or Correspondence codes.

So the Selectric-based terminals were slow (at best, 15 characters per second) and often awkward. But I still wanted my letters to go out without *looking* as if they were written by a computer. My friends might complain that they sounded as if they were written by a computer. They must look as though they came from a good office typewriter or—better still—from a printing press. There was *one* affordable (ouch!) answer.

I have always drooled over the Diablo and Qume print mechanisms. Elegant, fast, variable font, quiet, and with the ability to plot thrown into the bargain! But even *used* daisy-wheel printers cost at least $2500. Still, I decided that my budding computer system was going to have one of these "flowers" of the com-

Jef Raskin may be reached at Box 511 Brisbane, CA 94005



Qume Printer Mechanism

puter industry come what may.

How the Alternate Mechanisms Work

The idea behind the daisy-wheel printer is so simple that I wonder it was not thought of when the ancient Teletype™ device was first designed.

The Teletype print head is a cylinder that both rotates and moves up and down to position a character next to the ribbon. Then a hammer hits the cylinder and a character is printed. In the Selectric, the characters are on the surface of a sphere of metallized plastic. This sphere rotates and tilts to bring the appropriate character opposite the ribbon, it then violently nods its head, striking the ribbon and producing a character. Again, it takes two motions before it can strike.

Daisy-wheel printers have a wheel that does indeed look like some kind of gangly flower with nearly a hundred petals. Each petal has a letter or other printing character on it. The daisy wheel merely rotates to the proper position; a little hammer hits the individual petal (not the whole character set as with the TTY and IBM devices). And there you have it: beautiful printing. Since the daisy wheel has a simple motion, and only one petal has to move to create a character; the devices are fast, quiet, and much more reliable than the other impact printing mechanisms.

Plotting and Justification, Too

The daisy-wheel print mechanism is like the Selectric c u TTY in that the print wheel and its motor are moved horizontally along a track as the printing progresses across the paper while the paper and the platen (the rubber-covered cylinder that the paper wraps around) remain stationary. Vertical motion of the paper is accomplished by rotation of the platen.

By using digital motion for the platen and the daisy-wheel carrier, the manufacturers have achieved another advantage: plotting. In some models, the printers allow horizontal motions of only 1/120th of an inch, and vertical motions of 1/48th of an inch. The motion is bidirectional. You can move the paper up and down and print and plot forward and backward. The fine stepped horizontal motion allows rather pretty text justification as well so that both right and left margins of the page form straight vertical lines. Mainly all the program has to do is figure just how much the line has to be expanded to fit exactly and increase the horizontal spacing accordingly.

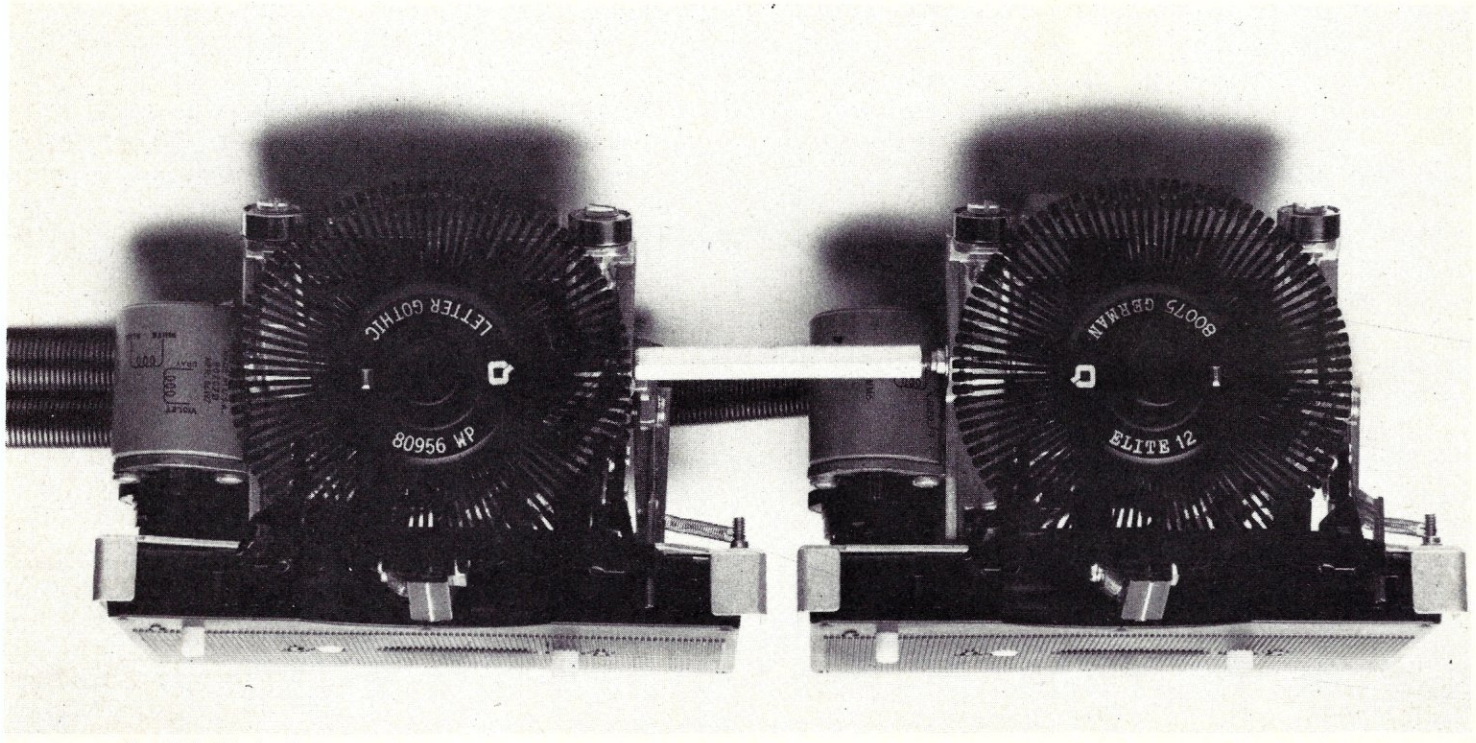
Bidirectional Movement

For really fast printing the daisy-wheel printers can print both forward and backward, so that no time need be wasted for carrier returns. This is neat to watch.

Other Printers Considered

A few other kinds of printers have gone unmentioned. Prominent among them are the thermal printers such as the ones Texas Instruments manufactures. These are fast and very quiet. But they require special paper and have mediocre print quality.

The other major kind of printer that got ruled out early in my search for true beauty on the printed page was the dot matrix printer. The fine Decwriters and the new hobbyist printers are good values if you just need the printed page. And if you don't mind seeing dots before your eyes. As I said, I have nothing against computers; I just want my letters not to look "computery."



Dual Print Mechanism

Finding a Daisy-Wheel Printer

For a moment, let me chronicle my attempt to find a used daisy-wheel printer. No way. Well, I did find *one*. It worked for a while. Then it didn't. A repair person came out to my place, somehow managed to switch boards while debugging it; and I was treated to a shower of sparks and a burned electronics smell that lasted long after the smoke had cleared. It went back. No sale.

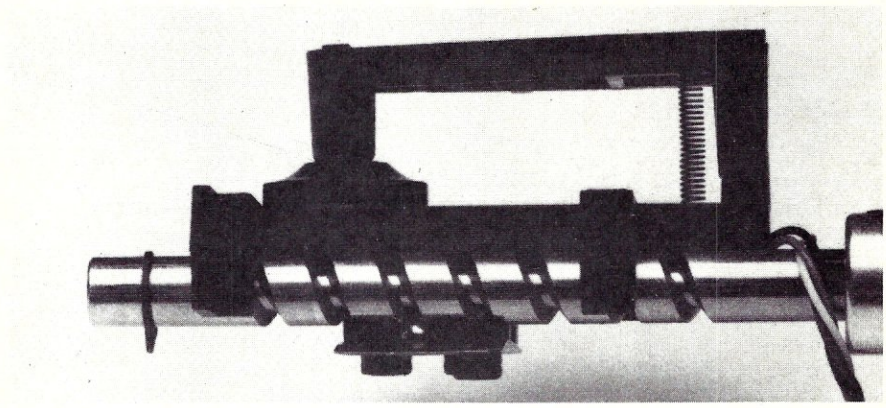
Since used daisy-wheel printers were (and still are) scarce, a *new* one was called for.

I was attracted to the Diablo 1620. It is the size of a large office typewriter. It is the only daisy-wheel printer that has a built-in power supply. Most of the others require an external box. The motors they use require gargantuan current surges to get started, so you just can't power it off the old computer. The trouble with the 1620 is that it costs just over $3000.

Another attractive machine—practically a computer system in itself—was the ITS (International Teleprocessing Systems) 8080A microprocessor-based wonder. This goes for a whopping $3700. Not to say that these machines aren't worth every penny. It's just that some of us don't have that many pennies. There had to be a way out. There was: Do It Yourself.

End User Terminals

Each of the end user terminals comes with a keyboard and all sorts of goodies. So miserly me looked at the possibility of buying a print mechanism, all unadorned and naked, and hooking it up to my computer. I already had a keyboard that talked to my computer, and it should be able to control the print mechanisms. Thus I could forget having to rebuy the keyboard and controllers, which must cost something and put the print mechanism in a simple box which could cost practically nothing, thereby saving a bundle. Now to choose among the daisy-wheel print mechanisms available.



Sector Select Mechanism

Choosing Among the Big Three

There are three that I know of: the Diablo, the Qume, and the Hewlett-Packard. They were developed in that order, and all use interchangeable print wheels—hard to believe, but they do! The H-P mechanism is out-of-the-question expensive (though devilishly clever). Between the remaining two, the Diablo mechanics seem to have more machined parts and fewer stampings than the Qume, and the ribbon cartridge is much easier to take in and out. This speeds up the changing of print wheels.

The Qume mechanism has variable hammer force, so that periods and commas are hit lightly, characters with large areas, W or M, for example—are hit harder. All three devices are comparable in capability. It's nothing against the Diablo mechanism that I happened to choose a Qume.

A 35-character-per-second Qume Sprint Micro/3 print mechanism costs $1300. (In quantities of 1000 you can pick it up for a mere $925.) You will need a power supply. Qume's is $330. A platen is $79. Cables and manuals cost about $100. In total, the Qume was $1,000 less than the Diablo 1620.

Driving the Print Mechanism

Now comes the moment you have been waiting for. Grab your soldering iron and your checkbook (the two tools most used in building home computers) and head for the nearest computer store.

To drive the print mechanisms requires no less than three parallel 8-bit output ports and one 8-bit parallel input port. I used the IMS four-barrel parallel I/O board. I've built two and had no problems. Buy the basic kit and four extra 8212's. That's a lot cheaper than buying the additional channels from IMS.

The 8212 is an 8-bit latch, and that's 99 percent of a parallel port. Put the LED's and the associated resistors in your spare parts box. All they do is waste power. Build the rest of the board per the instructions. (See Dr. Dobb's Journal, Vol. 1, No. 8, for a few hints on how to avoid problems.) I addressed my board so that the three ports were 64, 65, and 66 decimal (that's 40, 41 and 42 in hex). The input port comes out to be port 64.

The Qume has TTL level inputs and outputs. In practical terms, that means you can run wires directly from the top connectors on the parallel I/O board to the homongous ribbon cable on the Qume and everything will work—if they're connected correctly and the computer is programmed for the task.

I recommend purchasing the cables from Qume. They're hard to find otherwise. In my case I connected the I/O board to a 25-pin connector, on the back of the computer, and then attached a matching 25-pin connector to the Qume cable rather than connecting the Qume cable directly into the I/O board. You may choose otherwise. Leaving out the extra connectors will save you an hour of soldering, but it seems neater my way.

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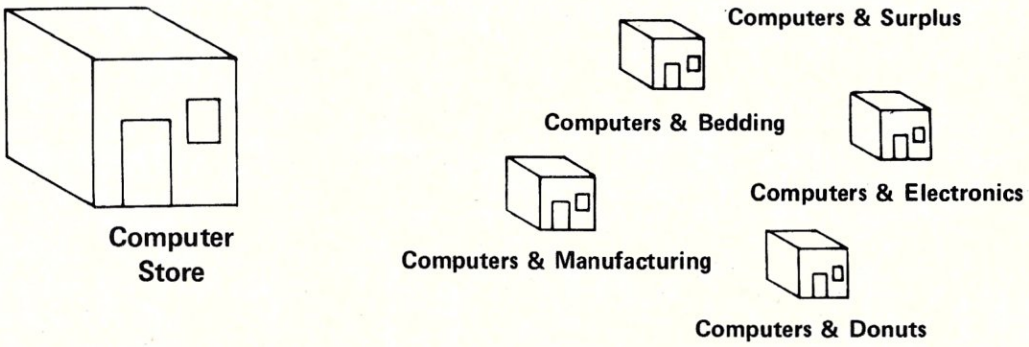

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Four Devices to Control

It takes so many ports because the printer is really four output devices. First, there is a daisy-wheel spinner; second, a platen rotater; third, a carrier mover; and fourth, a ribbon lifter. Each device has to be controlled separately. Fortunately, you only have to program it once to do all these things in the right order—but you must program it all. This is part of the price you pay for choosing to do it yourself. Of course, you have saved over $1,000 and are learning a lot.

In printing a line of text the program first checks to see if the printer is ready to accept a character. If not, the program waits. When the printer is ready the program sends a character in ASCII to the first port (port 64). The character has to be shifted left before being sent out—for reasons that will become clear later. Then the program sends a ribbon lift command and a character hammer strike command. This prints a character.

The character-hammer strike command is conventionally called a character strobe. It tells the printer that all the data defining the character is ready. Now that a character has been printed, the carrier (the part that holds the print wheel) has to be moved over. So the number of 120ths of an inch (60ths of an inch on some printers) has to be put into the first two ports and the carrier strobe command sent to the third port.

Why does it take two ports to send the distance the carrier is to be moved? Because the platen is over 14 inches wide, and there are over 255 units of 1/120th of an inch in 14 inches. It takes 12 bits worth of data, so all of the first port is used plus half of the second port (8 + 4 = 12) to specify an arbitrary carrier motion. The 12th bit is a sign bit, and the carrier moves right if it is zero, and left if it is one.

A negative strobe consists of dropping a signal low and then raising it after a short delay. The Qume uses such negative pulses whenever a strobe is required. Thus, as shall be seen, it takes two I/O instructions to send a strobe. One to make it go low, another to pick it back up.

This completes the first half of the interfacing; each input required by the printer has been attached to an output from a parallel port. Each output from the printer has been wired to an input to the parallel input port. Putting the right bits in the right order to these lines is the second half of interfacing—the software that will run the printer.

TABLE 1 INTERFACE SIGNALS AND PIN ASSIGNMENTS

	Program Word Bit Number	IMS PIO-4 Output Connector	IMS PIO-4 Input Connector	DB 25 S/P Connector*	Qume Interface Connector	Qume Printer Function	Bit Value; Useful in Programming
PIO-4 Port 1 Output Assigned 64_{10}	1	4		15	2	DATA ½ (ASCII character)	
	2	6		1	3	DATA 1 (ASCII character)	
	3	8		2	4	DATA 2 (ASCII character)	
	4	10		3	5	DATA 4 (ASCII character)	
	5	12		4	6	DATA 8 (ASCII character)	
	6	14		5	7	DATA 16 (ASCII character)	
	7	16		6	8	DATA 32 (ASCII character)	
	8	18		7	9	DATA 64 (ASCII character)	
PIO-4 Port 2 Output Assigned 65_{10}	1	3		8	10	DATA 128 (Carrier motion in 1/120-inch increments)	
	2	5		10	11	DATA 256 (Carrier motion in 1/120-inch increments)	
	3	7		11	12	DATA 512 (Carrier motion in 1/120-inch increments)	
	4	9		12	13	DATA 1024 (Carrier motion in 1/120-inch increments)	
	5	11				Direction of carrier motion (0 = left)	
	6	13					
	7	15					
	8	17					
PIO-4 Port 3 Output Assigned 66_{10}	1	29		13	16	RESTORE STROBE	1
	2	31		9	18	CHARACTER STROBE	2
	3	33		25	20	CARRIER STROBE	4
	4	35		24	22	PAPER FEED STROBE	8
	5	37		22	28	RIBBON LIFT	16
	6	39		23	26	TOP-OF-FORM STROBE	37
	7	41					64
	8	43		20	32	PRINTER SELECT	128
PIO-4 Port 1 Input Assigned 64_{10}	1		4	18	41	INPUT BUFFER READY	
	2		6	19	37	CHECK	
	3		8	16	49	PAPER OUT	
	4		10	21	30	RIBBON OUT	
	5		12	17	47	PRINTER READY	
	6		14				
	7		16				
	8		18				

*The use of this pair of mating DB25 connectors at the computer chassis is optional.

Basic Program Sequence

Here is the basic sequence that the program must follow:

1. Initialize the printer.
2. Send a character.
3. Lift the ribbon.
4. Strobe to print a character.
5. Send a carrier move distance.
6. Strobe the carrier.
7. Repeat from step 2.

Carrier returns, plotting, form feeds, and the like have to be programmed differently in detail; but the basic character printing sequence is a model for all of them. The Qume interface manual spells everything out in great detail. Since you get one with your printer, I won't reprint it here. But a few comments on the seven steps will give a good idea of what the software has to do.

Step 1: Initializing the Printer

The hardware initialization is done automatically by the printer electronics whenever power is supplied. It is also done whenever the RESTORE line is strobed low. All the signals are active low, that is, a logic zero will activate the desired function.

How do you make the restore line (or any line for that matter) low or high? From Table 1, we see that the third port (in decimal, port 66), IMS output lines 29 through 43, has the RESTORE, the strobes, and other miscellaneous signals. To send a RESTORE (and nothing else), we have to strobe line 29 low and leave everything else high—with one exception, we must always keep PRINTER SELECT low so that the signal will get to the printer.

The PRINTER SELECT line is there to give the programmer an easy way, for example, to have two printers operating in parallel from the same port and, by switching that one bit on and off, sending stuff to both or just one. In all these examples, we will keep it low.

So we now want PRINTER SELECT and RESTORE low and everything else high. Writing down the output lines from high order (37) to low order (30) and writing a one underneath those that are to be high and a zero under those to be low, we obtain:

38	37	36	35	34	33	32	31
0	1	1	1	1	1	1	0

treating the sequence of zeros and ones as a binary number (or as 7E in hex, or as 176 in octal) we find its value to be (in decimal) 126. So sending the value 126 to port 66 will do a restore. In those BASIC's that have an OUT instruction, we would use:

```
OUT 66, 126
```

In most assembly languages we would move 126 into the accumulator and then do an output to port 66 although we could use the hex or octal representations of the port (depending on the assembler) and the value.

Similarly, we can send any combination of signals by finding the binary number, as was just done, and choosing the correct port. Keeping in mind that PRINTER SELECT is low for all of these, the initialization looks like (in BASIC)

```
110 REM MAKE SURE EVERYTHING
    IS HI
120 OUT 66, 254
130  REM DO QUME INITIALIZATION
140 OUT 66, 126
170 REM SEE QUME MANUAL FOR
    DETAILED EXPLANATION
```

The line numbers are, of course, arbitrary and are just chosen for illustration.

Step 2: Sending a Character

The first port (data 1/2 through data 64) is multiplexed. This jargon word merely means that it has at least two uses (interpretations) at different times. Data 1 through data 64 are used to send an ASCII code for a character to the printwheel. Later, these same lines will control the carrier motion. How can the computer tell the difference? A different strobe will be sent out.

Working in BASIC again, let's say we wish to send the ASCII character code for "A" (65 decimal) to the printer. In binary, this is 1000001. But remember that the low-order bit of the interface (data 1/2) is not used. So we have to shift the code over to the left (toward the high order side of the byte) by one place. In binary, we get 10000010, which in decimal is 130. In machine language, we can just use a left shift to do this motion. In BASIC, we can do it by multiplying by 2. Try it if you are not familiar with this trick. (Adding a number to itself, by the way, is faster than multiplying by two.)

Remembering that the printer's inputs are all active low, we know that we must send not 10000010 but 01111101—having changed all the zeros to ones and vice versa. In machine language, this is called complementing. In BASIC, we can subtract the number from 255. With the left shift trick in mind, if we have the value of the desired character code in the variable C, then we can send it to the printer with the instruction.

```
OUT 64, (255—(2*C) )
```

If this is not clear then the reader is dared to translate a few examples into binary and see that subtracting a number from 255 effectively complements it. This assumes a number between 0 and 255 inclusive is being complemented. (Another way to complement a number is to tell it that it is in prime condition or is looking positively perfect today.)

Steps 3 and 4: Ribbon Lift and Character Strobe

Now the printer knows what character we are about to print. So send a RIBBON LIFT command, along with a CHARACTER STROBE. I am sure you have not forgotten PRINTER SELECT as well. Now the printer will indeed print the character.

Steps 5 and 6: Moving and Strobing the Carrier

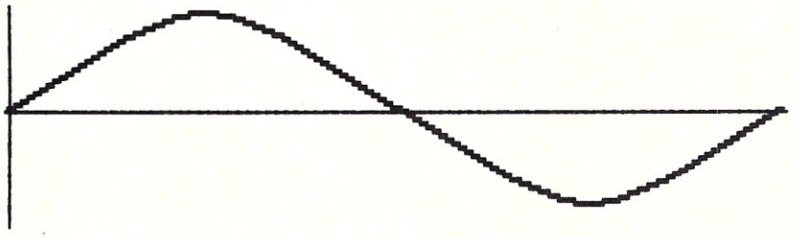
The process is similar to printing a character in that we are going to set up a distance to be moved and then send a strobe saying, "Move it!"

Distances are measured in 60ths of an inch. If data 1 is set low that means 1/60th of an inch. Data 2 means 2/60th, data 4 signifies 4/60ths and so on. If all the data bits except data 4 and data 16, for example, were 1 and CARRIER STROBE was made low; then the carrier would move 4/60ths plus 16/60ths or 1/3 of an inch to the right. You can specify distances up to the full width of the platen (over 15 inches). The data 1/2 bit means a motion of 1/120th of an inch. But the data 1024 bit is not 1024/60ths of an inch (which is some 17 inches, putting the carrier through the right side of the printer) but indicates, when low, that the motion is to be to the left instead of to the right.

A BASIC program to move the carrier to the right Y inches might be like this one:

```
100 REM CALCULATE NUMBER OF
120 THS OF AN INCH IN Y INCHES
110 S=Y*120
120 REM SET THE DATA 1204 BIT IF
    S IS NEGATIVE FOR LEFT MOVE.
130 IF S<0 THEN S=2048-S
140 REM SPLIT OFF THE LOW ORDER
    BITS, COMPLEMENT AND SEND
150 REM THEM TO PORT P (DEFINED
    AS 64 IN THE INITALIZATION).
160 OUT P,255-(S AND 255).
170 REM THIS ASSUMES A BITWISE
    "AND" AS IN MITS BASIC.
180 REM SEND HIGH ORDER BITS
    TO PORT Q (65).
190 OUT Q,255-INT (S/256)
200 REM WAIT FOR THE PRINTER
    TO BE READY. I.E. CHECK IF
    BIT 0.
210 REM OF PORT P IS 0. IF IT IS NOT
    ZERO PRINTER IS NOT READY.
220 REM THE FOLLOWING STATE-
    MENT DOES IT ALL IN MITS
    BASIC
230 WAIT P,1,1
240 REM ACTIVATE THE STROBE
    (R IS DEFINED AS 66)
250 OUT R,255-(4+128)
260 REM THE 4 IS THE STROBE BIT,
128 THE PRINTER SELECT
270 REM NOW TURN THE STROBE
    OFF, LEAVE PRINTER SELECT
280 OUT R,255-128
```

Another way of doing what line 230 does is



Graphic Plot

```
230 IF (INP (P) AND 1) <>0 THEN
GO TO 230
```

this will sit, spinning, until bit 0 goes low.

Note on line 130: What is happening in this deceptively simple statement is this: We are adding 2048 to |s| in order to set DATA 1024, which has a bit value of 2048 in the carrier-motion mode.

Moving the Paper Up and Down

Similar techniques are used for moving the paper up and down. Here 48ths instead of 120ths of an inch apply, and your program has to figure out that a RETURN means to move the carrier to the left and to rotate the platen the correct amount. This does imply that your program has to keep track of where the carrier is, but this is merely cumulative addition.

It is easiest to simply move the carrier a standard amount whenever a character is struck; but when this simple printing is mastered the program can move further for large letters (like "m" and "w") than for narrow letters. This is proportional spacing and makes the output look much more like the printed page. It is not difficult to make a program adjust the interword spacing so that both the left and right edges of the text are aligned vertically. This is called justification. With a good editing and justification program, and a carbon ribbon in the printer, you can turn out camera ready copy and go into business as a typesetter in the graphic arts.

Since you have complete control over the motion of the carrier and platen, it is also possible to do plotting. Closely spaced dots approximate lines and curves. A treatise on computer graphics is outside the scope of this article; but a little imagination can take you into some interesting graphics, and the computer literature is full of articles on how to do it.

I'd like to make a request of my readers: I have found that these articles engender a lot of letters asking questions. I will answer them (sooner or later) if they contain a self-addressed stamped envelope.

Thank you.

Acknowledgements: To Doug Wyatt, who created at least three quarters of the interface, 2nd to Walt Thompson and Brian Howard, who made many valuable suggestions on how to improve this article—Thanks.

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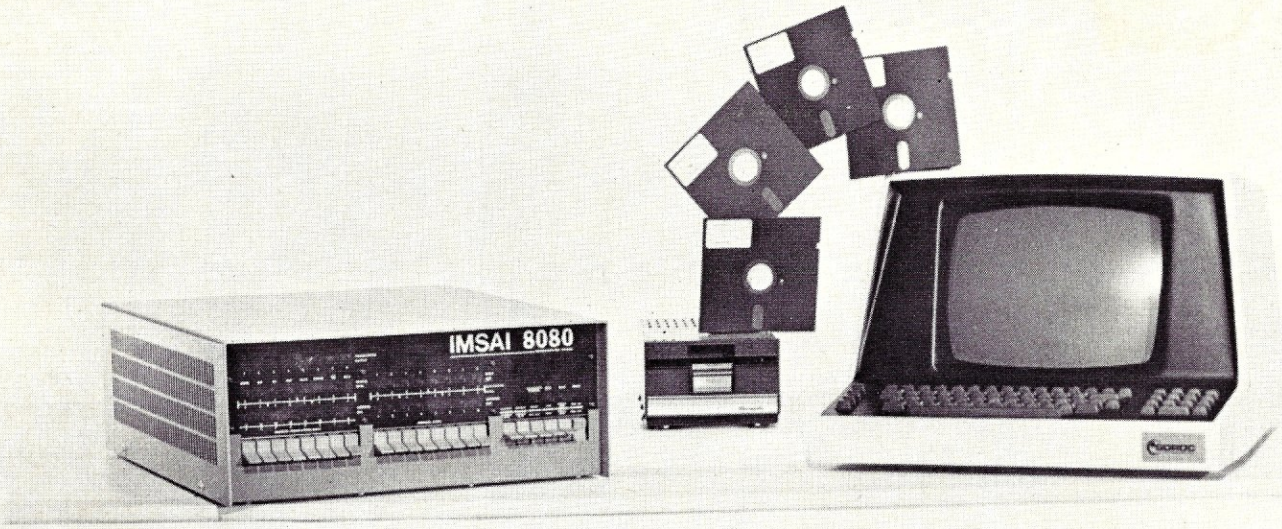

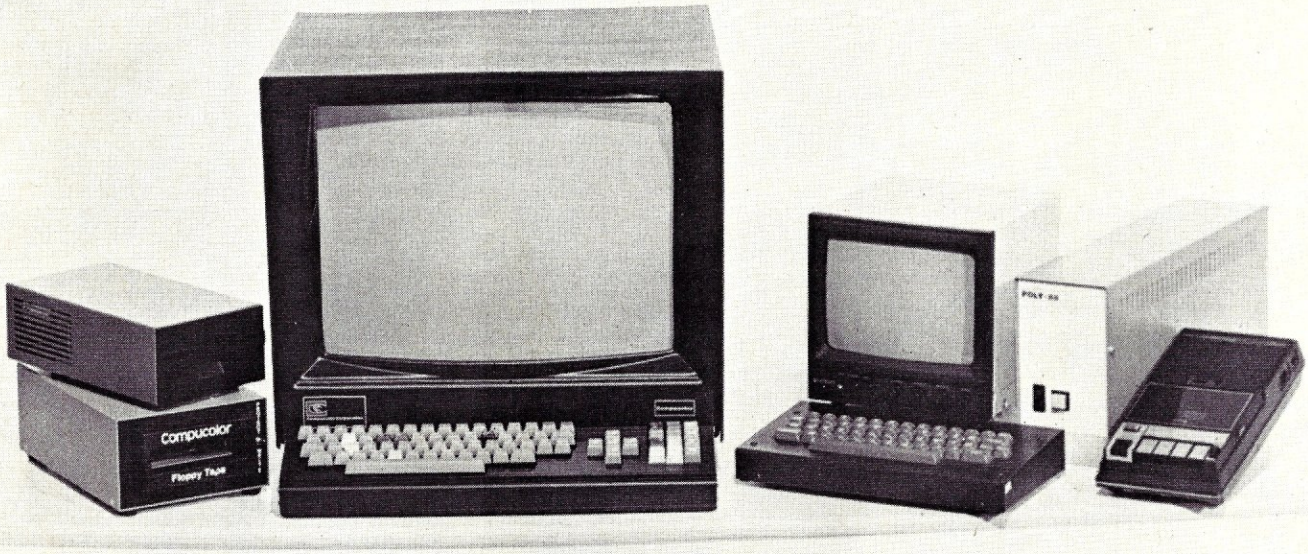

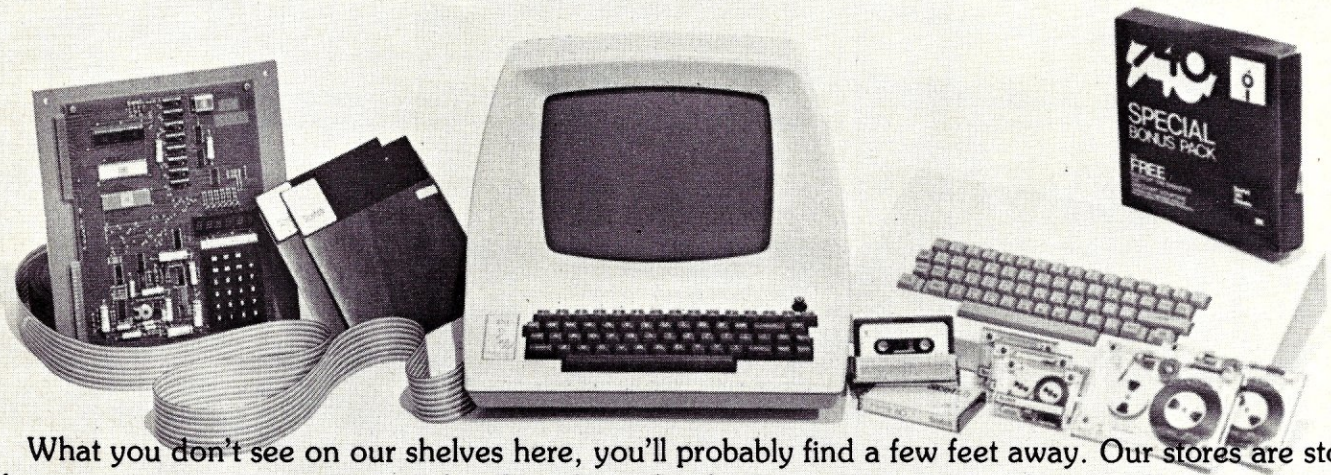

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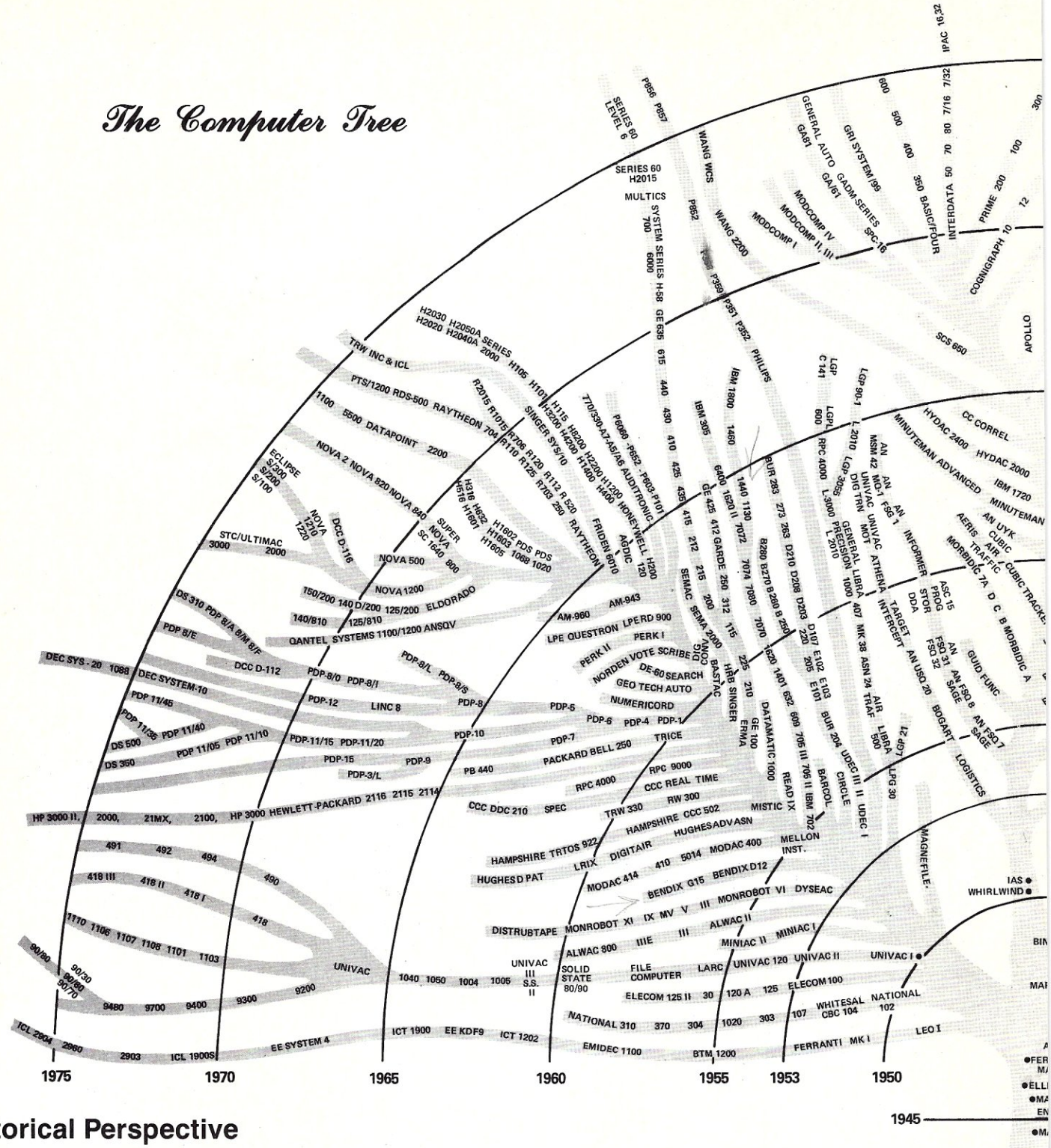
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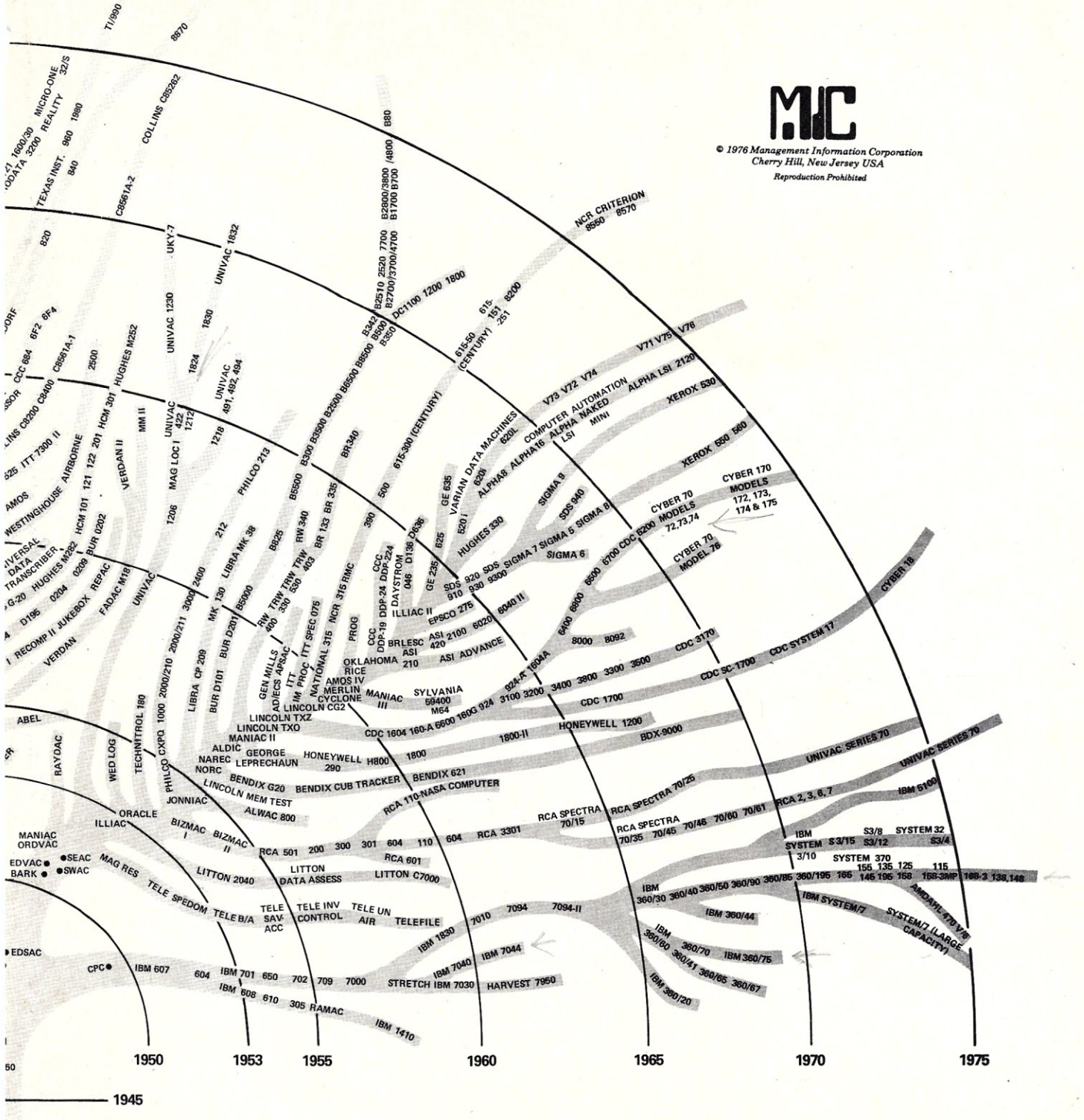
Historical Perspective

Many hobbyists are newcomers to the field and may be laboring under the impression that the computer was invented by Ed Roberts and first documented in *Popular Electronics*.

That's really not the case. Three streams of development preceded today's computers. We have an ancient history of notations for the representation of quantity, we have a slightly more recent history of inventing machines for computation (analog and digital) and most recently (17th Century), we began to invent programmable machines. Thus marks on stones, Roman Numerals, Stonehenge, abacii, Burrough's adding machines, complex dolls built as toys for French Kings, and Jacquard Looms must all be counted as steps toward the Altair.

More recently, men such as Babbage, Hollerith and Von Neuman began to pull these conceptual streams

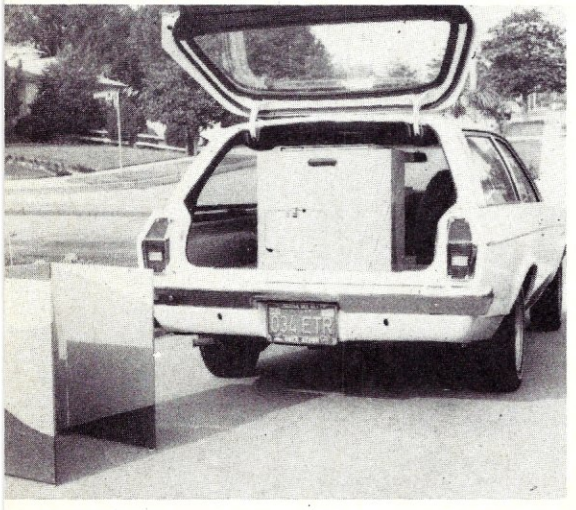


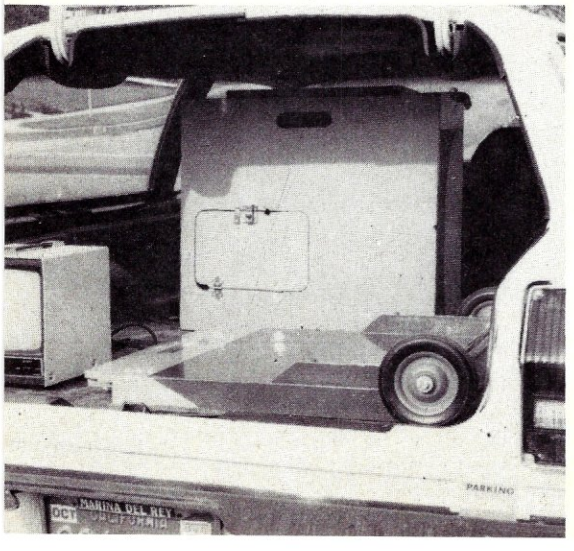
together, and men such as John Atanasoff, Eckert and Mauchley began to construct electronic machines.

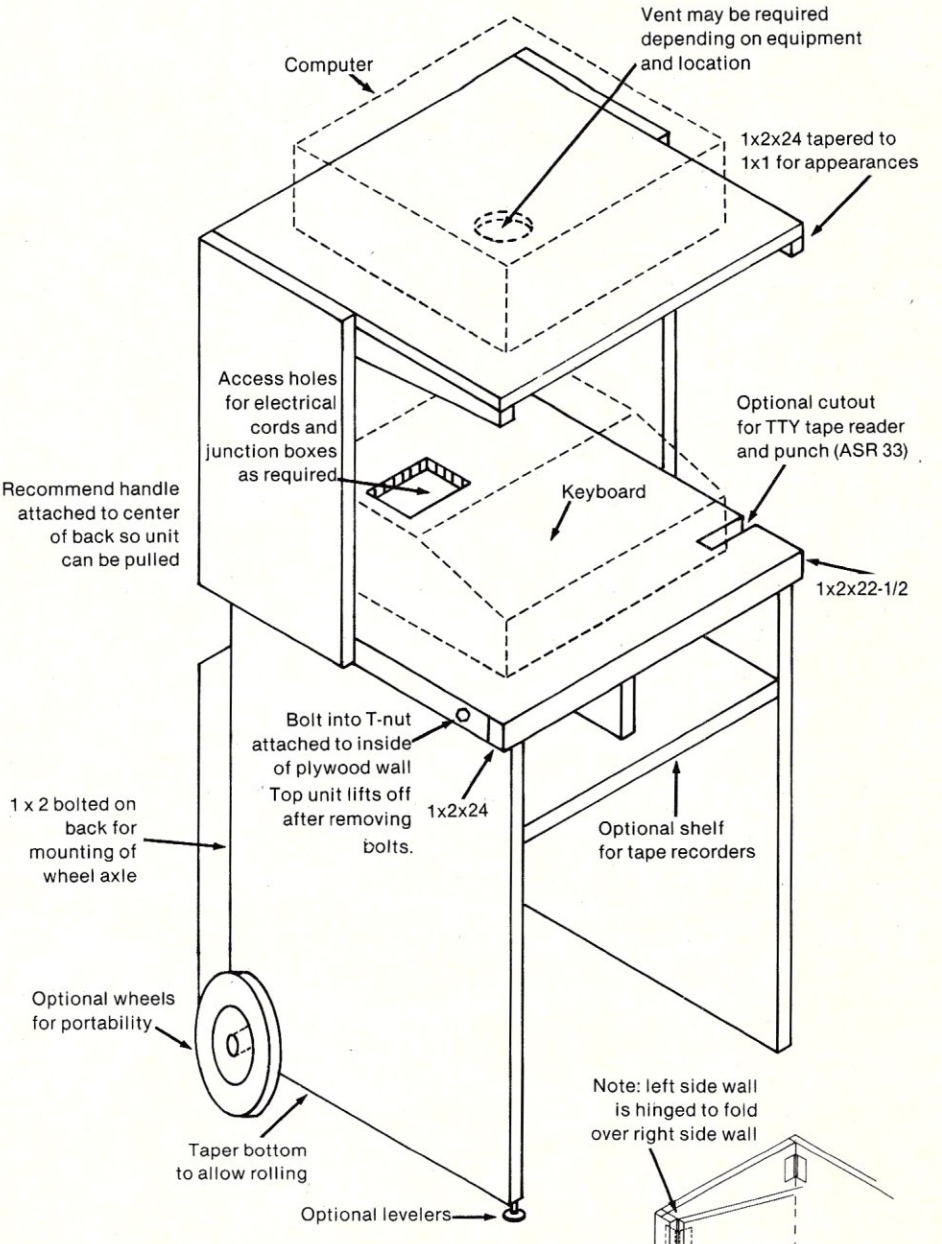
Our centerfold illustrates the recent fruit of this work. In roughly 25 years, we have developed literally thousands of varieties of electronic digital computers (Von Neuman anticipated nearly all of them). Our micros are merely a large leaf on a well rooted tree.

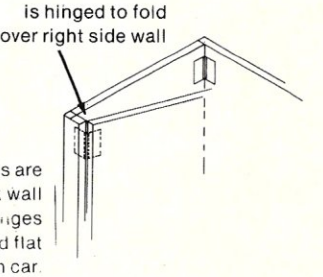
The centerfold, "Computer Tree", was prepared by Lawrence Feidelman, President of Management Information Corporation, 140 Barclay Center, Cherry Hill, NJ 08034. He sells posters of this illustration for $10.00 but is offering a special price of $7.50 for ICS members. Write him directly and include your membership number.

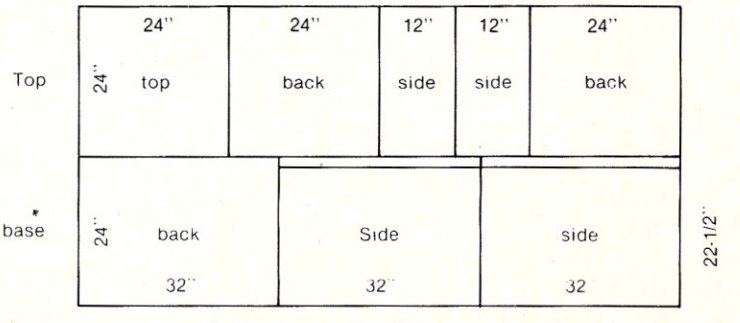
Art Armstrong's Computer House






Vent may be required depending on equipment and location
Computer
1x2x24 tapered to 1x1 for appearances
Access holes for electrical cords and junction boxes as required
Optional cutout for TTY tape reader and punch (ASR 33)
Keyboard
Recommend handle attached to center of back so unit can be pulled
1x2x22-1/2
Bolt into T-nut attached to inside of plywood wall
Top unit lifts off after removing bolts.
1x2x24
1 x 2 bolted on back for mounting of wheel axle
Optional shelf for tape recorders
Optional wheels for portability
Taper bottom to allow rolling
Optional levelers


Note: left side wall is hinged to fold over right side wall
Lower side walls are attached to back wall with hinges so unit will fold flat to fit in car.



Cutting diagram for 1/2" or 3/4" plywood

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8238	8.20
8251	12.00
8253	28.00
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8259	22.00

6800 SUPPORT

6810P	6.00
6820P	8.00
6828P	9.60
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6850P	12.00
6852P	17.00
6860P	15.00
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Z80 SUPPORT DEVICES

3881	15.95
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F-8 SUPPORT DEVICES

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FLOPPY DISC CONTROLLER

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1771	69.95

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1103 (16P)	1.50
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2107B-4 (22P)	4.00
TMS4050 (18P)	4.50
TMS4060 (22P)	4.50
4096 (16P)	5.50
MM5262 (22P)	3.00
MM5270 (18P)	5.00
MM5280 (22P)	6.00

STATIC RAMS

31L01	2.00
91L11A	4.25
91L12A	4.25
1101A	1.00
2101	3.00
2102 (10S)	1.25
2102-1 (5.00NS)	1.50
2M1A-4	4.45
2112A-4	3.00
2501B	1.45
3107	2.95
*4200A (250NS)	13.75
410D (200NS)	11.95
*4804	20.00
5101	20.00
74C89	3.00
74S201	4.75
91L02A	2.00
7489	2.25
8225	1.50
8599	1.50
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*Limited supply.

MISC OTHER COMPONENTS

NH0025CN	1.75
NH0026CN	3.00
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N826	3.25
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2533V	2.00
TMS3002	1.00
TMS3112	3.95
MM5058	2.00

FIFO

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2812-D	11.95

KEYBOARD CHIPS

AY5-2376	14.95
AY5-3600	14.95

TV GAME CHIPS

TMS 1955 (6 Games)	10.95
AYSS-8500 (6 Games)	10.95

USRT

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IM-6403	10.80
TMS-6011 (TI)	6.25
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UARTS

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CHARACTER GENERATORS

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2513	6.75
3257	18.00
MCM6571	10.80
MCM6571A	10.80
MCM6572	10.80
MCM6581	8.75

WAVEFORM GENERATOR

8038	4.50
MC4024	2.75
566	2.00

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1702A	5.00	5204AQ	10.00
1702AL	7.00	6834	21.95
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2708	24.00	82S23B	4.00
2716	75.00	82S129B	4.25
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* WILL WORK WITH NO FRONT PANEL
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* LOW POWER SCHOTTKY SUPPORT IC'S

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Circle Number 59 on Reader Service Card

New Products

Roger Zimmerman

The purpose of the New Products department is to give our readers a running state-of-the-art view of products and developments in the microcomputer field. It provides a forum in which manufacturers, inventors, and computer enthusiasts can expose their newest creations to an eager and knowledgeable public for first reactions, criticism, and purchase.

There is another important link in this feedback loop. All of us have dreams of products or services that we would like to see someone else come up with because we don't have the requisite skills, time, energy, or development money. In some cases, these products and services may already exist and it's just a matter of matching up the interested parties. Or, it may be that the concept for the desired product is brand new or has never been articulated in a clear enought fashion to motivate those individuals with the skill, knowledge, and resources necessary to make the concept a reality.

Here's where you come in. Send us your suggestions for new products, services, programs, tools, reference resources, unusual applications, etc. Write them down as clearly as you can, including prospective prices, technical details, etc. Include your name and address and phone number so that interested people can contact you. We'll edit and print as many of these ideas as we can under a new heading "Things I'd Like to See . . ." in the New Products section. Maybe we can exert some influence on the development of new products and services in this way and match them up with the people that need them.

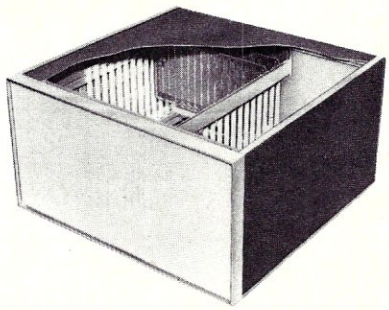
Send your ideas and comments to Microcomputer Interface, New Products Editor, 1415 Second St., Santa Monica, CA 90401.

Standards Newsletter

Circle number 11 on Reader Service Card

To help solve some of the standards problems in the hobbyist computer and microcomputer field, ALF Products is sponsoring a Central Standards Library.

After discussions with several manufacturers in this field at the West Coast Computer Faire, ALF has set up the CSL as a means of standards information exchange for manufacturers, consumers, hobbyists, and others interested in standards. The Library will collect submitted standards and distribute them on a non-profit basis. For more information on available standards, on how to submit standards, and on the Library's services; send $1 (to cover printing and mailing costs) to: **The Central Standards Library**; C/O ALF Products, Inc.; 128 S. Taft; Denver, CO 80228. You will receive a copy of the first CSL Newsletter and the first submitted standard (a parallel interface standard). Manufacturers currently participating include: ALF Products, IMSAI Manufacturing, PolyMorphic Systems, Proko Electronics, Vector Graphic, and Video Terminal Technology.



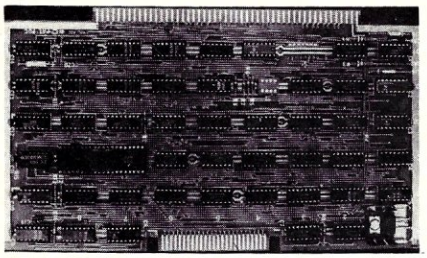
Low-cost Enclosures

Circle Number 1 on Reader Service Card

Two new low-cost enclosures, from Vector Electronic Company, give system developers an alternate choice in packaging IMSAI, ALTAIR, and other 5.31 inch by 10 inch (13.48cm by 25.4cm) cards with S-100 bus configurations.

The enclosures are form compatible with IMSAI and ALTAIR minicomputers, the VP2 having front-to-back card orientation while the VP1 has side-to-side card orientation. A sturdy aluminum chassis at the rear or side supports power supplies and other heavy components. Two dozen plastic guides are supplied separately so that the user may position 12 cards in any location and with any board spacing. The cases have space for 21 cards on 0.75 inch (1.90cm) centers. Adjustable slots allow convenient mounting of receptacles or a mother board. No cutting or drilling is required for card mounting. Both cases are 17.85 inch wide by 9.01 inches high by 17.1 inches deep overall (45.34cm by 22.89cm by 43.43cm). The fully-assembled cases have .062 inch (1.6 mm) thick slide-in blue vinyl covered aluminum panels. These provide smooth surfaces unmarred by unsightly screws and fasteners, yet provide fast access to internal equipment. Bottom panels have slotted holes, and rubber stand-off pads, for convection cooling. Front and rear panels are recessed to prevent inadvertent activation of switches or damage to cables. Optional accessories include a pre-punched rear panel with ten holes for 25-pin "D" type connectors, Vector's 8800 series prototyping cards for S-100 bus systems, and a wide variety of sockets, connectors, pins and tools. The VP1 and VP2 microcomputer enclosures are $128.30 and $134.30, respectively.

Contact **Vector Electronic Company,** 12460 Gladstone Avenue, Sylmar, CA 91342. (213) 365-9661.



S-100 Floppy Controller

Circle number 3 on Reader Service Card

The μPAL FDC 1016 Floppy Disk Controller provides a high quality, low cost, floppy disk controller for S-100 bus compatible microcomputers. The software supported unit handles up to eight disks under direct memory access (DMA) to achieve a large data storage base.

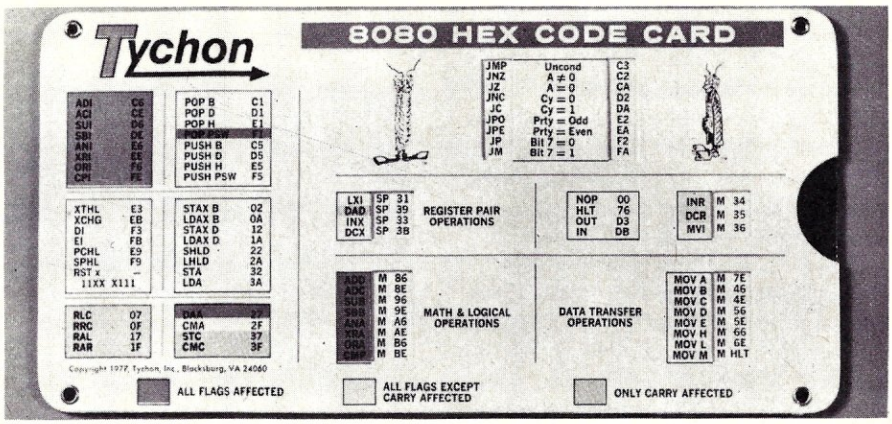
The single card unit (assembled, tested and with sockets) sells for $418. The controller card plus a single disk drive are $995. A disk file management software package, tapes and listings, is available for $25. Disk formatting capabilities are provided. IBM 3740 and many other formats are possible, along with error detection features. Operating under the DFM 80 portion of the software package, the user need only be concerned with the name of the file, the operation to be performed and the physical disk upon which the file resides. In addition, the software package contains a MONITOR, DEBUGGER and BOOTSTRAP programs. A SYSGEN program formats disks and establishes linkages to the operating system. The user is thus provided with sophisticated tools for adapting their own programs or operating systems for floppy disk based operation. For further information, please contact **Processor Applications, Ltd.,** 2801 East Valley View Avenue, West Covina, CA 91792, (213) 965-8865.

Dynamic Debugging System

Circle number 15 on Reader Service Card

The Dynamic Debugging System (DDS) is a powerful debugging facility for 8080 assembly language programs. DDS operates in a variety of ways which you select to meet your needs.

DDS can run your program one instruction at a time, automatically maintaining on the screen a display of all registers, the following instructions, and portions of memory. Like conventional debugging programs DDS can also operate in a breakpoint mode in which the program runs at full speed until it reaches one of several selected instructions. Although a breakpoint capability may be necessary, if it is the only facility available the debugger will be tedious to use, since you will have to breakpoint around almost all branch instructions. The automatic program monitoring facilities provide a powerful alternative to the drudgery of using breakpoints. Rather than running the program yourself with breakpoints, DDS can run the program for you, until a condition you have specified occurs or DDS detects an error by itself. The cost is $30.00 on paper tape or cassette and $35.00 on diskette. For further information contact: The **Computer Mart of New Jersey,** 501 Route 27, Iselin, New Jersey 08830, 201/283-0600.



8080 Hex Code Card

Circle number 6 on Reader Service Card

Tychon Incorporated is pleased to announce its 8080 Hex Code Card. The code card is a slide rule-like aid for programming and debugging 8080 software. It contains all the mnemonics and their corresponding hexadecimal codes.

The instructions are all color coded to indicate which flags are affected during execution. The pocket sized card measures 6.5 by 3 inches and it provides the instructions in a neat, logical format for quick reference. The back side of the card is printed with an ASCII code chart for all 128 characters plus the 8080 status word and register pair codes. The price is $2.95 postpaid. Quantity discounts start at ten units and custom printing is also available. For further information write or call C. A. Titus at **Tychon, Inc.,** P.O. Box 242, Blacksburg, VA 24060, (703) 951-9030.

How to Start a Computer Store

Circle number 7 on Reader Service Card

Consumer Computer Marketing, Inc. A Boston-based consulting firm specializing in the personal and microcomputer market announces its latest report, a How-To-Do-It manual for would-be retail computer entreprenuers and established computer store-type outlets: "HOW TO START A COMPUTER STORE AND KEEP IT RUNNING".

The package includes a 175 page manual and features and audio cassette transcription of the three hour session presented at this years National Computer Conference's Personal Computing session by Paul Conover, a principal consultant with CCM and includes presentations by Richard Brown of the Computer Store, Inc., a northeastern chain of computer outlets and David Bunnell, publisher of the popular computer magazine *PERSONAL COMPUTING*. The manual covers Funding, Site Selection, Store layouts, Vendors and Suppliers, Inventory, Employees, Business laws, Advertising and Promotion Techniques, Selling and Closing Sales, Software and Applications, New Market Opportunities, Credit, and many other aspects of this unique new retail industry. The complete manual and tape cassette is available for $200 from the **Audio Visual Department/CCM, Inc.,** Post Office Box 7343, Oakland, CA 94601.

Dual Minifloppy for SWTPC 6800

Circle number 13 on Reader Service Card

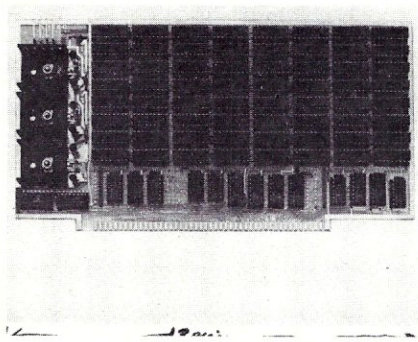
The $995 MF-68 Minifloppy Disk System is designed for use with the SWTPC 6800 Computer System. It includes all hardware and software needed to provide a complete high-quality dual-disk operating system.

The system can be expanded to its four-drive limit with an $850 MF-6X expansion kit. The extensive software provided with the MF-68 includes both disk BASIC and a floppy disk operating system (FDOS). Operating system commands make disk operation, including copying all or any part of one diskette onto another, simple and easy. Commands include CREATE, SAVE, RUN, LOAD, PURGE (delete), PACK, CATALOG, RENAME, INITIALIZE and PATCH. The MF-68 is offered in kit form only. It includes controller, chassis, cover, power supply, interconnecting cables, assembly instructions, two assembled Shugart minifloppy drives, and a diskette with the FDOS operating system and disk BASIC. The MF-6X expansion kit includes power supply, chassis, cover, and two assembled minifloppy drives. Prices include prepaid postage. Further information is available from **Southwest Technical Products Corp.,** 219 W. Rhapsody, San Antonio, Texas 78216.

8-Octave Pitch Generator Board

Circle number 12 on Reader Service Card

The 10-5-9 and 10-5-10 Quad Chromatic Pitch Generator boards are designed to be a low-cost start in computer-controlled music generation. The single board Pitch Generator produces one to four tones simultaneously. Each of the four tones are separately controlled and can produce any of 96 tones which form an 8 octave range. This covers the entire standard piano range, plus 8 higher pitches. Special connections allow later expansion with accessory boards to control various sound parameters. Using the optional on-board crystal oscillator or a 2 MHz source (external or pin 49 on the S-100 bus) all pitches are within 0.1% of the A = 440 Hz standard. The 10-5-9 is S-100 compatible, and the 10-5-10 is compatible with parallel output ports. Kit prices for both versions range from $111 to $159 (depending on the number of simultaneous tones), the assembled price is $185. Oscillator is an additional $16. Available for product evaluation: data sheet (free), demonstration record ($1), and owner's manual ($3 plus $1 postage). **ALF Products, Inc.;** 128 South Taft; Denver, CO 80228, (303) 234-0871.

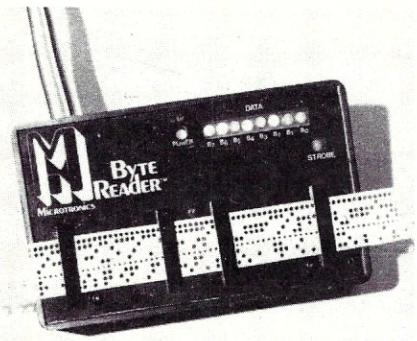


32K Expandable Memory Board

Circle number 14 on Reader Service Card

Artec Electronics, Inc., has introduced a 32K byte static memory board in modular form designed primarily for microcomputer hobbyists but also applicable for small business uses.

Designated 32K-100, the board is fully compatible with the S-100 data bus and speed-compatible with Zilog Z80-based systems. The basic board with all support circuits, power regulator, 8K bytes of memory and assembly manual sells for $290. Additional 8K bytes of static RAM cost $255 each, and full 32K memory board sells for $1,055. The 32K-100 require plus-8 voltage with a power usage of 3 amps; access time of the DMA-compatible board is 250 nanoseconds. DMA compatibility allows users to access memory directly without going through the central processing unit (CPU) on the microprocessor board. The 32K board, fully buffered on all address and data lines, also features battery back-up (allowing operating at reduced power consumption), and a "bank select" provision so users can select the blocks, or banks, of memory they want to address. According to Artec President Robert Jones, "This way, you add 24K memory to the original 8K without any additional investment in more hardware." For more information, contact Robert Jones at **Artec,** 605 Old County Road, San Carlos, CA 94070, (415) 592-2740; or Paul Plansky at **Tycer-Fultz,** Palo Alto, (415) 328-6300.



Optical Paper Tape Reader

Circle number 10 on Reader Service Card

Microtronics is proud to announce the availability of our newest product, the BYTE READER™, an inexpensive, yet versatile, optical paper tape reader designed to fill the needs of the computer hobbyist.

The BYTE READER™ features an exclusive LITE OPTIMIZER™ circuit which senses the intensity of the external light source and automatically adjusts the sensitivity level of the photo transistors for proper operations. It also features LED data bit indicators which enable you to visually verify data being sent to the computer, and has an acrylic front panel with photo mask backing which gives it a professional look. The kit sells for $69.95 or fully assembled for $84.50. Include $3 shipping and handling and 6% CA tax if applicable. For more information write to: **Microtronics,** P.O. Box 7454N, Menlo Park, CA 94025. Dealer inquiries invited.

Calculator Interface to Microprocessor

Circle number 9 on Reader Service Card

An interface board utilizing hardware for mathematical calculations, employing a scientific calculator circuit for use by 8080, Z-80, 6800 and other microprocessor systems has been made available by Mini Micro Mart.

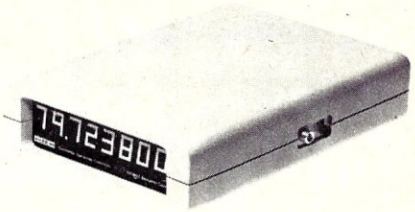
The interface is to a powerful, scientific calculator chip produced by MOS Technology, the 7529-103; basic and complex math functions can be done with simple software and the absolute minimum of system memory. This board permits the user to perform many math functions not provided for in many of the BASIC and Fortran interpreters and also provides for calculations to a higher degree of precision. Calculations utilizing interpreters or compilers that would require 8K to 16K of memory can be done in under 1K. The user has available the functions of a fully programmable, sophisticated 40-key scientific calculator including trig functions, inverse trig, logarithms, antilogarithms, exponentiation and factorials; it directly supports two parentheses levels. The user can take advantage of the board's capabilities in three manners; it could be used to supplement the functions of a small interpreter, as a stand-alone firmware math package, or it could be programmed to emulate the functions of a powerful, programmable calculator. Two versions of the board are available—the RM Series with a pin-out that matches the Motorola Exercisor bus and which could be adapted readily to an Intel SBC 80/10 system; and another version is produced in a personal computing S-100 standard bus convention. Software is included for both 8080 and 6800 systems. The board is available in kit form at $99.95. For further details, contact **Mini Micro Mart,** 1618 James Street, Syracuse, New York 13204, or phone (315) 422-4467.

Space Saving Terminal

Circle number 8 on Reader Service Card

A small, low cost, highly reliable alphanumeric display terminal designed as an alternative to a CRT is now available from Computerwise, Inc.

The Transactor I Data Terminal consists of a single line 32 character gas discharge display with a 5 x 7 dot matrix for easy reading, and a 53 key TTY Style keyboard. It can be attached to almost any computer, with an RS-232 or 20 mA current loop interface. Switches allow the user to select the operating mode including; 110-9600 baud rate, full or half duplex, even/odd/no parity, five to eight data bits, and one or two stop bits. Ideal for applications where low cost and minimum size are factors, the Transactor is designed as an alternative to large or expensive CRT terminals. Practical applications include retail sales, hospital patient accounting, general accounting, inventory control, computer programming, production control, and instrument monitoring. Lightweight and small, the Transactor is housed in an attractive and sturdy aluminum case that measures only 6" high x 15" wide x 11" deep. A stylized molded case is available. Price of standard Transactor I in quantity is $595.00 For more information, contact **Computerwise, Inc.,** 4006 East 137th Terrace, Grandview, MO 64030, (816) 765-3330.



20Hz—100MHz Frequency Counter

Circle number 4 on Reader Service Card

Continental Specialties Corporation (CSC) announced their new MAX-100 solid-state frequency counter. It provides accurate frequency readings from 20Hz to a 100MHz for audio, ultrasonic, RF (AM and FM), video and digital applications.

A clip-lead or other input cable, or a mini-whip antenna is plugged in, and the unit turned on. MAX-100 automatically gives direct frequency readings on its 8-digit, 0.6" LED display. Read-out is updated once a second, and overflow signals (above 100 MHz) are automatically indicated. Measuring 1.75 x 7.38 x 5.63" (4.45 x 14.30 x 19.69cm), it weighs less than 1.5 lbs. (0.68Kg). It can operate on six AA cells (alkaline or rechargeable NiCad), 110 or 220VAC (with charger/eliminator), 12VDC (with mobile charger/eliminator) or any 7.2-10VDC supply. It has a 3.57MHz crystal-controlled timebase with 3ppm accuracy and high temperature stability. An integral, wide-range preamplifier allows inputs as low as 30mV, diode overload protection is provided up to a maximum of 200V peak. MAX-100 is supplied with a plug-in clip-lead input cable and detailed application/instruction manual. Optional accessories include a mobile charger/eliminator for recharging NiCad batteries and operating from a 12V auto cigarette lighter; 110VAC and 220VAC charger/eliminators for recharging NiCad's and operating from the AC line; a low-loss tap-off for connecting to transmitters-CB, amateur and commercial, test equipment and RF lines; a mini-whip antenna for use where direct coupling is not practical or desired.

The MAX-100 is available for $139.95 from CSC dealers. For more information, contact **Continental Specialties Corporation,** 44 Kendall Street, New Haven, CT 06509, (203) 624-3103 or 351 California Street, San Francisco, CA 94104, (415) 421-8872.

Personal Computer Network

The PCNET (Personal Computer NETwork) Committee has been functioning in the Palo Alto, California area since April. The committee's goal is the creation of regional (followed by national) personal computer networks for the computer-to-computer transfer of messages and files. A set of network protocols (sets of conventions defining all levels of intercomputer communication) is almost completely designed. These protocols should be operable in 8K bytes of machine code, and are designed to be implemented in string BASIC.

The committee believes this should be attractive to personal computer users. Participation will be voluntary; you can decide to participate (or not) on any given day of network operation. Network functioning will be relatively insensitive to the absence of an appreciable fraction of member computers.

Our current thinking indicates the following tentative equipment required for participation in the network: a personal computer with 12-16K of RAM and string BASIC and an originate/answer MODEM capable of 300 BPS.

A message service—the ability to send a message (generally English text, although almost any file can be sent) is quite valuable. It doesn't sound very dramatic, but it is surprising how powerful such a message exchange facility is. Ordinary message services (telephone, telegraph, mail) are too slow (mail); often hard to catch someone (phone); hard or time consuming to use (mail, telegrams); expensive in terms of characters per dollar (phone, telegrams); etc. A computer based message system overcomes most of these difficulties.

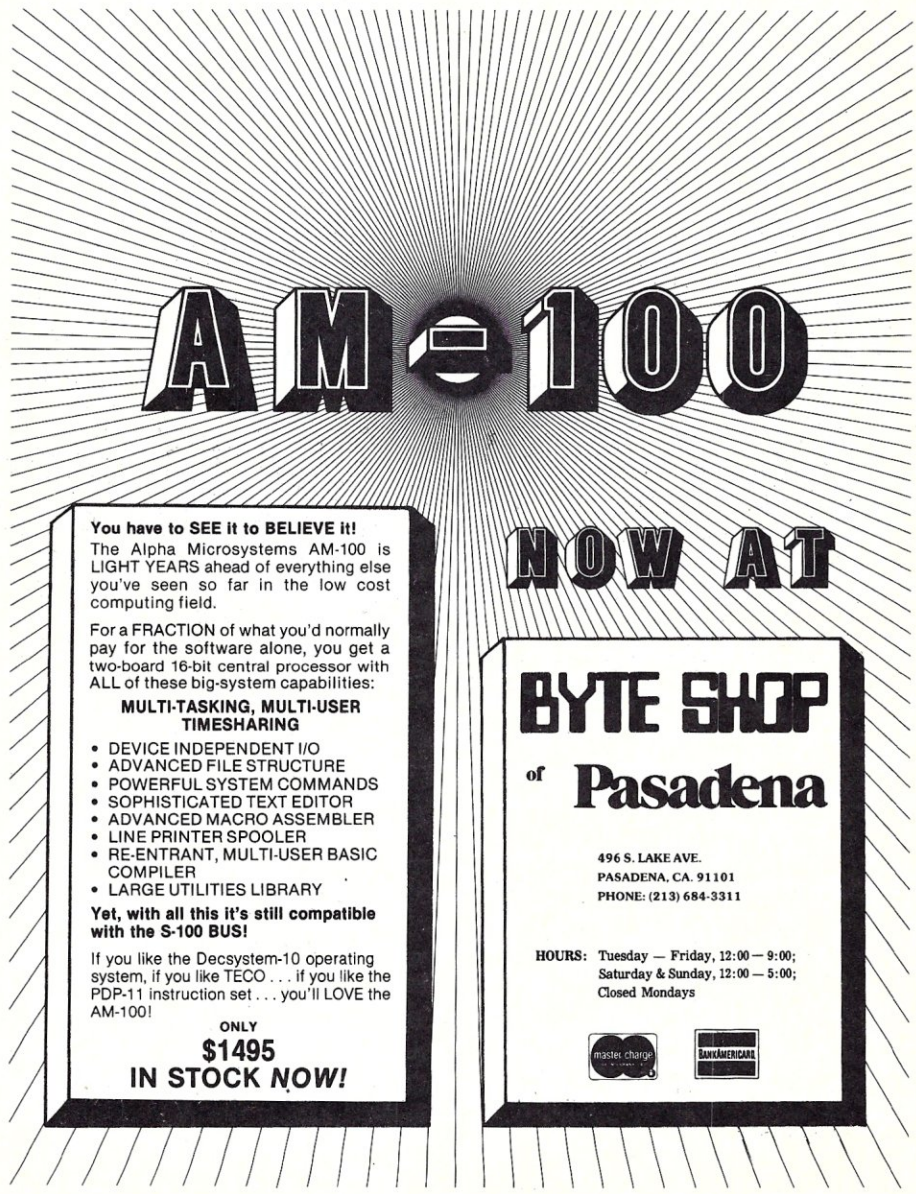
People regularly using such a system rapidly develop a whole new communication style. Most messages are brief—500 characters or less. Content tends to be much more informal and direct than conventional media such as business letters. Message system users move rapidly toward a computer-based personally oriented file system containing messages, distribution lists, text files, etc. The difference is one of kind, not just of degree.

The PCNET Committee is about to start a series of experiments. We would welcome people with personal computer systems who would like to participate; we're especially interested in people in the Palo Alto dialing area. We would also be most interested in similar network efforts in other places. We'd like to avoid west coast chauvinism and want to work closely with people in other parts of the country.

For further information write or call: Dave Caulkins (415) 328-2411 (wk), (415) 948-5753 (hm). 437 Mundel Way, Los Altos, CA 94022.

This strikes me as a most important contribution. I hope that others who are working on networks and radio communication will contact Dave. I want to be in Kansas City when we drive the golden spike into the Peoples Communication Link from Los Angeles to New York!

Larry Press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Science Fiction Corner

"Star Wars" Breaks the T.V. Habit

By Lew Whittaker

For all of the "trekkies" of the world who thought that television was the medium and *Star Trek* was the message, hold everything! A new cult has recently been spawned, or at least it is now in the process of being developed. This will be the cult of Luke Skywalker, the Force, R2D2, the Empire, etc. Already Hollywood has begun to cash in on the startling popularity of this movie. T-shirts, emblems, helmets, and those fantastic laser swords are now being marketed to further the legend (and the profits) of *Star Wars*.

This is a Hollywood film, and as such, carries with it a built-in taint of crass commercialism superficiality, and non-character development. Keeping all of this in mind, I still feel that *Star Wars* is about the best science fiction film I have ever seen. For fan of fantasy or the bizarre, it had about every ingredient demanded or desired—intergalactic conflict, action, technological wizardry, action, B.E.M.'s, action, robots, good guys, bad guys, a beautiful princess, and more action.

Seldom in today's world of "gore equals reality" philosophy, can one see a truly swashbuckling, romantic adventure without close-up details of gory mayhem thrust on the viewer. But here is a film jammed with visual magic and yet it leaves enough to the viewer's imagination to build an even more fanciful story in his mind.

For those readers old enough to remember the Saturday serials in the movies, it is the "complete full-length serial"—a combination of Buck Rogers, Hopalong Cassidy, Tarzan, and Terry and the Pirates. This last comment is not meant to be a put-down. My youthful excitement at watching my hero get into a most impossible situation, and wondering what miracle he would use to escape the sinister evil-doer was worth many hours of weekly speculation. *Star Wars* had the same building waves of tense excitement and hairbreadth escape—all jammed into two hours.

This is the type of movie that does not stand up well under point-by-point dissection. I'm sure that many movie critics can find many important areas to criticize negatively. The story is pretty trite; the format, as I have stated, is strictly Saturday serial, the acting is barely adequate. However, the movie is much more than the sum of its parts—it is a total experience.

As a matter of fact, if there is a candidate for best actor, I would have to divide the award between the two Laurel and Hardy-type robots, or Droids, as they were referred to, R2D2 and C3P0. These Droids were charming, clever, had good lines, and definitely captured the sympathies and the hearts of the audience. They were a step above the plodding, mindless lumps of mobile metal that the word "robot" usually brings to mind. In fact, they were a step above the plodding, mindless actors that are seen in most Hollywood films.

I mentioned earlier that critics might find areas of the movie to criticize negatively, but one area that I feel is totally above any negative comments is that of the special effects. In a single word, they were incredible! From the opening scene of the looming Empire battle ship to the final battle scene of the Rebel mosquito-like fighters attacking the giant, seemingly impregnable space station, the effects were mind boggling. In the same vein, the collection of Inter-Galactic space creatures gathered together in the disreputable bar waiting for an opportunity to make an honest (or preferably, a dishonest) dollar were everything that one would imagine an off world humanoid to be—weird, alien, yet strangely human in their actions and desires.

One cannot get through a discussion of STAR WARS without mentioning the classic conflict of good and evil: the "FORCE" and the Rebels trying desperately (but fairly) to get out from underneath the crushing boots of DARTH VADER and the Empire. The good guys were really good and the bad guys were really bad—there was no middle ground of characterization here. I cannot help but feel that even in this era of film realism, neo-realism, nihilism, anti-hero worship, etc., a corny classic confrontation in which the good guys win out in the end is kind of a nice change of pace. So what, that sometimes right does not always triumph in real life. So what, that sometimes in real life even the seemingly nicest of people don't do nice things all of the time. So what, to all of the critics of the movie. STAR WARS is the stuff that fairy tales are made of.

Fortunately (or unfortunately as the case may be), a movie that has generated so much excitement, to say nothing of revenue, can hardly be put to rest. I am sure that we will soon be seeing sequel after sequel—perhaps "Son of Star Wars", "Bionic Star Wars" or maybe even "Frankenstein meets Wolfman in a Star War". If it sells, why not?

Software Exchange

A Comprehensive Memory Test for the 8080

Next Month – Memory Test for MITS 680

By Frank McCoy

Having spent several hundred hours debugging my company's 8800 and then spending several hundred more helping my friend debug his, one of the necessary tools turned out to be that old stand-by the memory test.

A memory test is generally used to test out the computer when simpler methods say that the machine is OK but further verification is needed. The reason that a memory test is used, is that most of the problems encountered with the computer involve "flaky" memory. This is easy to understand, when you consider that everything that the CPU does relies on having at least some working memory.

After having used several dozen memory tests several hundred times apiece, some from magazines and some that I wrote myself, I came to the conclusion that none of the tests that I had seen contained all the necessary functions that were desired in a really good memory test.

I therefore decided that if the mountain wouldn't come — etc. so I started to design my own good memory test.

The first thing that I did is to decide what were the desired functions and features of the ideal memory test program. I will cover each point as compared to standard designs.

First: It Must Be Thorough

A. Most simple memory tests simply select a byte, shove it throughout the test area, and then check to see if it is still there. This method will not uncover the type of error caused by adjacent pattern interference or that caused by poor address decoding. To rectify this problem, my memory test would include three entirely different types of patterns. First: a psuedo-random pattern (based on the cyclic redundancy check) would be placed throughout the test area. Then a check would be made on the pattern to see if it was still correctly held by the memory.

Second: a pattern of alternating ones and zeroes (checkerboard) is stored and tested.

Third: a pattern of all ones is stored and tested.

Fourth: each of the preceding tests is repeated with the complement of the pattern that was used the first time.

B. Most simple memory tests do not catch timing-sensitive problems. Either they immediately check to see if the byte that they stored is correct, and miss problems of the sort where the memory forgets after a while, or they do not test for problems that occur when the memory is rapidly and repeatedly accessed. To cover both problems my memory test would first store the whole test pattern throughout the test area before coming back to test to see if it was correct. Also the test would use the 8080 "pop" & "push" instructions. These two instructions perform the fastest access of memory. For two sequential bytes, of any of the memory access instructions of the 8080 CPU.

C. By doing every test twice, the second time with the complement of the first, every bit in the test area will have been tested six times, three times in each state.

Second: It Must Be Fast

A. Most simple memory tests are fast, but most that make any claim to being thorough, are anything but. I have run across machine language memory tests that would take weeks just to check 16K of memory. This is intolerable if you want to know if the change you just made really fixed that memory board or not. By using several complex tests rather than one simple test repeated endlessly, I can achieve a high degree of confidence without endless agonizing.

B. Obviously the program must be written in machine (assembly) language rather than interpreted if one wishes to finish sometime in the same year as when you start.

Third: The Memory Test Should Be Easy To Use.

A. Some memory tests require that you use the front panel of the computer to interpret the results of your test. This is both awkward and time-consuming. My memory test would prompt you from the terminal that you ordinarily use. It would ask you what the starting address and ending address of memory is that you want to test. Then it would let you know if the test passed or failed, and if it failed it would tell you where the failure was, what the test byte was, what the error byte was, and finally which bit(s) were in error. All input and output should be in an easily machine-related format, i.e., either octal or hexadecimal (I use octal).

Fourth: It Should be Completely R.O.M.-able

In other words if the problem is placed in read-only-memory it will require no external RAM to work. The program should use only the internal registers for variables and no stack which also means no standard call -able subroutines. This will allow one to test memory when the only working memory is the board, be it ROM or RAM, which contains the memory test itself.

After all that introduction, here is the resulting memory test. You can judge for yourself whether it meets the criteria as set above.

Frank McCoy may be reached at (213) 644-7395

```
 1  000 000                  /MEMORY TEST
 2  000 000                  /
 3  000 000                  /V 1.4
 4  000 000                  /7/27/77
 5  000 000                  /
 6  000 000                  /BY FRANK MCCOY
 7  000 000                  /
 8  000 000                  /THIS MEMORY TEST WAS DESIGNED
 9  000 000                  /WITH FOUR MAJOR OBJECTIVES IN
10  000 000                  /MIND:
11  000 000                  /
12  000 000                  /1. IT MUST BE THOROUGH
13  000 000                  /   A. CHECK FOR PATTERN SENSITIVITY
14  000 000                  /   B. CHECK FOR MORE THAN 1 TYPE
15  000 000                  /      OF PATTERN
16  000 000                  /   C. CHECK FOR SPEED SENSITIVE
17  000 000                  /      MEMORY
18  000 000                  /   D. CHECK FOR DATA RETENTION
19  000 000                  /   E. CHECK FOR ADJACENT DATA
20  000 000                  /      INTERFERENCE
21  000 000                  /   F. CHECK FOR ADDRESSING ERRORS
22  000 000                  /   G. CHECK FOR ADDRESS INTER-
23  000 000                  /      FERENCE
24  000 000                  /
25  000 000                  /2. IT MUST BE FAST
26  000 000                  /   A. DO ALL OF ITS TESTS IN LESS
27  000 000                  /      THAN 1/2 SECOND PER 4K BOARD
28  000 000                  /
29  000 000                  /3. BE EASY TO USE
30  000 000                  /   A. INTERFACE TO MITS SERIAL I-O
31  000 000                  /   B. GIVE PROMPTS WHERE NEEDED
32  000 000                  /   C. INPUT THE RANGE OF TEST IN
33  000 000                  /      OCTAL
34  000 000                  /   D. OUTPUT THE ADDRESS OF THE
35  000 000                  /      ERROR IN OCTAL
36  000 000                  /   E. TELL WHAT THE TEST AND ERROR
37  000 000                  /      BYTES WERE
38  000 000                  /   F. TELL WHICH BITS WERE IN ERROR
39  000 000                  /
40  000 000                  /4. BE COMPLETELY ROM-ABLE
41  000 000                  /   A. USE NO RAM FOR THE TEST
42  000 000                  /      EXCEPT THE AREA THAT IS
43  000 000                  /      UNDER TEST
44  000 000                  /   B. ALL VARIABLES ARE HELD WITHIN
45  000 000                  /      THE CPU REGISTERS
46  000 000                  /   C. USE NO STACK FOR SUBROUTINES
47  000 000                  /
48  000 000                  /
49  000 000                  /
50  000 000                  /ALL SUBROUTINE CALLS IN THIS
51  000 000                  /PROGRAM ARE UNCONDITIONAL JUMPS
52  000 000                  /PRIOR TO JUMPING TO THE DESIRED
53  000 000                  /SUBROUTINE, THE CALLING PROGRAM
54  000 000                  /SAVES THE DESIRED RETURN ADDRESS
55  000 000                  /IN THE H&L REGISTERS.
56  000 000                  /THIS IS DONE SO THAT THERE IS NO
57  000 000                  /NEED FOR A STACK POINTER OR
58  000 000                  /STACK AREA.
59  000 000                  /EVERY TEST IS REPEATED WITH THE
60  000 000                  /COMPLEMENT OF THAT TEST.
61  000 000                  /THE FIRST TWO TESTS USE A RANDOM
62  000 000                  /SERIES FOR THE TEST
63  000 000                  /THE SECOND SET OF TWO TESTS USE
64  000 000                  /ALTERNATING ONES AND ZEROES
65  000 000                  /THE THIRD SET OF TWO TESTS USE
66  000 000                  /ALL ONES AND THEN ALL ZEROES.
67  000 000                  /
68  000 000                  /
69  000 000                  /THE 'BEGIN' ROUTINE TURNS OFF THE
70  000 000                  /RECORDER (NECESSARY ON MY MACHINE)
71  000 000                  /INITIALIZES THE MITS SERIAL I-O
72  000 000                  /AND CLEARS THE SCREEN ON MY TVT.
73  000 000                  /
74  000 000                  ORG 0 0
75  000 000                  /
76  000 000  257             BEGIN, XRA
77  000 001  323 300         OUT 300
78  000 003  076 003         LAI 3
79  000 005  323 020         OUT 20
80  000 007  076 025         LAI 25
81  000 011  323 020         OUT 20
82  000 013  041 024 000     LXH START
83  000 016  001 136 002     LXB MSG0
84  000 021  303 026 001     JMP MSGOUT
85  000 024                  /
86  000 024                  /
87  000 024                  /THE 'START' ROUTINE, INPUTS THE
88  000 024                  /STARTING AND ENDING ADDRESSES
89  000 024                  /FROM THE KEYBOARD AND THEN SETS
90  000 024                  /UP FOR THE FIRST TEST
91  000 024                  /
92  000 024  041 035 000     START, LXH ST1
93  000 027  001 151 002     LXB MSG1
94  000 032  303 026 001     JMP MSGOUT
95  000 035                  /
96  000 035  041 043 000     ST1, LXH ST2
97  000 040  303 052 001     JMP INOCT
98  000 043                  /
99  000 043  120             ST2, LDB
100 000 044  131             LEC
101 000 045  041 056 000     LXH ST3
102 000 050  001 201 002     LXB MSG2
103 000 053  303 026 001     JMP MSGOUT
104 000 056                  /
105 000 056  041 064 000     ST3, LXH ST4
106 000 061  303 052 001     JMP INOCT
107 000 064                  /
108 000 064  142             ST4, LHD
109 000 065  153             LLE
110 000 066  371             SPHL
111 000 067  041 001 000     LXH 1 0
112 000 072                  /
113 000 072                  /
114 000 072                  /'LOOP1' STORES RANDOM NUMBERS
115 000 072                  /THROUGHOUT THE TEST AREA
116 000 072                  /BY USING RANDOM NUMBERS MOST
117 000 072                  /PATTERN SENSITIVE AND ADDRESSING
118 000 072                  /PROBLEMS WILL BE CAUGHT.
119 000 072                  /THE NUMBERS ARE STORED USING THE
120 000 072                  /8080 "PUSH" COMMAND WHICH STORES
121 000 072                  /TWO ADJACENT BYTES IN THE FASTEST
122 000 072                  /MANNER POSSIBLE WITH THIS CPU.
123 000 072                  /THIS HELPS TO CHECK FOR TIMING
124 000 072                  /SENSITIVE PROBLEMS
125 000 072                  /
126 000 072  063             LOOP1, INXS
127 000 073  063             INXS
128 000 074  345             PUSH
129 000 075  341             POPH
130 000 076  041 000 000     LXH 0 0
131 000 101  071             DADS
132 000 102  171             LAC
133 000 103  225             SUL
134 000 104  170             LAB
135 000 105  234             SBH
136 000 106  332 144 000     JTC DONE1
137 000 111                  /
138 000 111  073             DCXS
139 000 112  073             DCXS
140 000 113  341             POPH
141 000 114  175             LAL
142 000 115  207             ADA
143 000 116  157             LLA
144 000 117  174             LAH
145 000 120  027             RAL
146 000 121  147             LHA
147 000 122  076 000         LAI 0
148 000 124  215             ACL
149 000 125  157             LLA
150 000 126  174             LAH
151 000 127  007             RLC
152 000 130  007             RLC
153 000 131  007             RLC
154 000 132  255             XRL
155 000 133  017             RRC
156 000 134  017             RRC
157 000 135  346 001         NDI 1
158 000 137  255             XRL
159 000 140  157             LLA
160 000 141  303 072 000     JMP LOOP1
161 000 144                  /
162 000 144                  /
163 000 144                  /'DONE1' CHECKS THE FIRST TWO
164 000 144                  /BYTES FOR ERRORS AND ALSO CHECKS
165 000 144                  /TO SEE WHICH PASS-THROUGH THE
166 000 144                  /PROGRAM IS ON.
167 000 144                  /
168 000 144  153             DONE1, LLE
169 000 145  142             LHD
170 000 146  076 001         LAI 1
171 000 150  276             CPM
172 000 151  302 165 000     JFZ CHECK
173 000 154  075             DCA
174 000 155  043             INXH
175 000 156  276             CPM
176 000 157  302 232 001     JFZ ERROR
177 000 162  303 204 000     JMP LOOP2
178 000 165                  /
179 000 165  076 376         CHECK, LAI 376
180 000 167  276             CPM
181 000 170  076 001         LAI 1
182 000 172  302 232 001     JFZ ERROR
183 000 175  075             DCA
184 000 176  075             DCA
185 000 177  043             INXH
186 000 200  276             CPM
187 000 201  302 232 001     JFZ ERROR
188 000 204                  /
189 000 204                  /
190 000 204                  /'LOOP2' GOES BACK AND CHECKS TO
191 000 204                  /SEE IF WHAT IS STORED THROUGHOUT
192 000 204                  /MEMORY IS STILL THE SAME AS WHEN
193 000 204                  /IT WAS STORED.
194 000 204                  /
195 000 204  176             LOOP2, LAM
196 000 205  027             RAL
197 000 206  053             DCXH
198 000 207  176             LAM
199 000 210  027             RAL
200 000 211  167             LMA
201 000 212  043             INXH
202 000 213  176             LAM
203 000 214  027             RAL
204 000 215  167             LMA
205 000 216                  /
206 000 216  043             INXH
207 000 217  171             LAC
208 000 220  225             SUL
209 000 221  170             LAB
210 000 222  234             SBH
211 000 223  332 274 000     JTC DONE2
212 000 226                  /
213 000 226  053             DCXH
214 000 227  176             LAM
215 000 230  007             RLC
216 000 231  007             RLC
217 000 232  007             RLC
218 000 233  053             DCXH
219 000 234  256             XRM
220 000 235  017             RRC
221 000 236  017             RRC
222 000 237  346 001         NDI 1
223 000 241  256             XRM
224 000 242  043             INXH
225 000 243  043             INXH
226 000 244  276             CPM
227 000 245  302 232 001     JFZ ERROR
228 000 250                  /
229 000 250  043             INXH
230 000 251  171             LAC
231 000 252  225             SUL
232 000 253  170             LAB
233 000 254  234             SBH
234 000 255  332 274 000     JTC DONE2
235 000 260                  /
236 000 260  053             DCXH
237 000 261  053             DCXH
238 000 262  176             LAM
239 000 263  043             INXH
240 000 264  043             INXH
```

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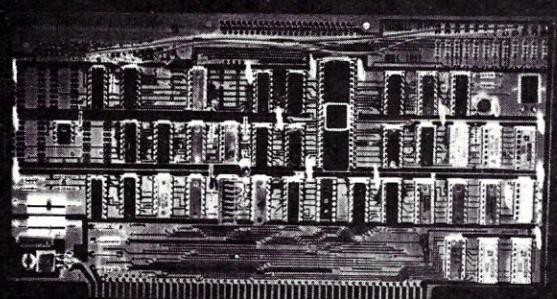

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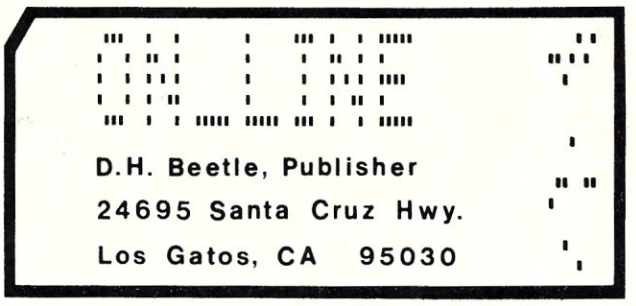
Circle Number 62 on Reader Service Card


```
241  000 265  276          CPM
242  000 266  302 232 001  JFZ ERROR
243  000 271  303 204 000  JMP LOOP2
244  000 274               /
245  000 274               /
246  000 274               /'DONE2' CHECKS TO SEE WHICH TEST
247  000 274               /HAS JUST BEEN DONE.  IF IT WAS
248  000 274               /THE FIRST TEST THEN IT SETS UP
249  000 274               /TO TEST THE COMPLEMENT, ELSE IT
250  000 274               /SETS UP FOR THE FINAL FOUR TESTS
251  000 274               /
252  000 274  153          DONE2, LLE
253  000 275  142          LHD
254  000 276  371          SPHL
255  000 277  041 376 377  LXH 376 377
256  000 302  032          LDAD
257  000 303  376 002      CPI 2
258  000 305  312 072 000  JTZ LOOP1
259  000 310  153          LLE
260  000 311  142          LHD
261  000 312  021 125 252  LXD 125 252
262  000 315               /
263  000 315               /
264  000 315               /'LOOP3' STORES THE TWO BYTES IN
265  000 315               /THE D & E REGISTERS THROUGHOUT
266  000 315               /THE TEST AREA
267  000 315               /
268  000 315  162          LOOP3, LMD
269  000 316  043          INXH
270  000 317  163          LME
271  000 320  043          INXH
272  000 321  171          LAC
273  000 322  225          SUL
274  000 323  170          LAB
275  000 324  234          SBH
276  000 325  322 315 000  JFC LOOP3
277  000 330               /
278  000 330  041 000 000  LXH 0 0
279  000 333  071          DADS
280  000 334               /
281  000 334               /
282  000 334               /'LOOP4' TESTS TO SEE IF THE DATA
283  000 334               /STORED THROUGHOUT MEMORY IS THE
284  000 334               /SAME AS THE D & E REGISTERS
285  000 334               /
286  000 334  172          LOOP4, LAD
287  000 335  123          LDE
288  000 336  137          LEA
289  000 337  276          CPM
290  000 340  302 232 001  JFZ ERROR
291  000 343  043          INXH
292  000 344  171          LAC
293  000 345  225          SUL
294  000 346  170          LAB
295  000 347  234          SBH
296  000 350  322 334 000  JFC LOOP4
297  000 353               /
298  000 353               /
299  000 353               /THIS ROUTINE FINDS OUT WHICH
300  000 353               /PASS-THROUGH THE PROGRAM IS ON
301  000 353               /AND THEN SETS UP TO DO THE NEXT
302  000 353               /
303  000 353  041 000 000  LXH 0 0
304  000 356  071          DADS
305  000 357  021 252 125  LXD 252 125
306  000 362  176          LAM
307  000 363  376 252      CPI 252
308  000 365  312 315 000  JTZ LOOP3
309  000 370               /
310  000 370  021 377 377  LXD 377 377
311  000 373  376 125      CPI 125
312  000 375  312 315 000  JTZ LOOP3
313  001 000               /
314  001 000  021 000 000  LXD 0 0
315  001 003  074          INA
316  001 004  312 315 000  JTZ LOOP3
317  001 007               /
318  001 007               /
319  001 007               /IF ALL THE TEST WERE GOOD THEN
320  001 007               /THIS ROUTINE CLEARS THE SCREEN,
321  001 007               /THEN PRINTS "OK" AND GOES BACK
322  001 007               /TO 'START'
323  001 007               /
324  001 007  041 020 001  LXH ST5
325  001 012  001 136 002  LXB MSG0
326  001 015  303 026 001  JMP MSGOUT
327  001 020               /
328  001 020  001 227 002  ST5, LXB MSG3
329  001 023  041 024 000  LXH START
330  001 026               /
331  001 026               /
332  001 026               /THIS ROUTINE PRINTS OUT WHAT
333  001 026               /IS POINTED TO IN MEMORY BY
334  001 026               /THE B & C REGISTERS UNTILL A
335  001 026               /ZERO BYTE IS FOUND.
336  001 026               /
337  001 026  012          MSGOUT, LDAB
338  001 027  247          NDA
339  001 030  302 034 001  JFZ AR1
340  001 033  351          PCHL
341  001 034               /
342  001 034  333 020      AR1, INP 20
343  001 036  346 002      NDI 2
344  001 040  312 034 001  JTZ AR1
345  001 043  012          LDAB
346  001 044  323 021      OUT 21
347  001 046  003          INXB
348  001 047  303 026 001  JMP MSGOUT
349  001 052               /
350  001 052               /'INOCT' INPUTS TWO BYTES OF SPLIT
351  001 052               /OCTAL DATA.  EACH BYTE IS TERMINATED
352  001 052               /BY A SPACE.  A CARRIAGE RETURN
353  001 052               /TERMINATES BOTH BYTES.  ZERO IS
354  001 052               /THE DEFAULT IF CARRIAGE RETURN IS HIT
355  001 052               /ANY ILLEGAL CHARACTER WILL SEND
356  001 052               /THE PROGRAM BACK TO START.
357  001 052               /
358  001 052  001 000 000  INOCT, LXB 0 0
359  001 055  333 020      LUP1, INP 20
360  001 057  346 001      NDI 1
```

```
361  001 061  312 055 001  JTZ LUP1
362  001 064  333 021      INP 21
363  001 066  323 021      OUT 21
364  001 070  366 200      ORI 200
365  001 072  376 240      CPI 240
366  001 074  312 143 001  JTZ LUP2
367  001 077  376 233      CPI 233
368  001 101  312 046 341  JTZ MONITOR
369  001 104  376 215      CPI 215
370  001 106  312 165 001  JTZ LUUP2
371  001 111  170          LAB
372  001 112  027          RAL
373  001 113  027          RAL
374  001 114  027          RAL
375  001 115  346 370      NDI 370
376  001 117  107          LBA
377  001 120  333 021      INP 21
378  001 122  366 200      ORI 200
379  001 124  326 260      SUI :0
380  001 126  332 024 000  JTC START
381  001 131  376 010      CPI 8D
382  001 133  322 024 000  JFC START
383  001 136  200          ADB
384  001 137  107          LBA
385  001 140  303 055 001  JMP LUP1
386  001 143               /
387  001 143  333 020      LUP2, INP 20
388  001 145  346 001      NDI 1
389  001 147  312 143 001  JTZ LUP2
390  001 152  333 021      INP 21
391  001 154  323 021      OUT 21
392  001 156  366 200      ORI 200
393  001 160  376 240      CPI 240
394  001 162  302 166 001  JFZ AR3
395  001 165  351          LUUP2, PCHL
396  001 166               /
397  001 166  376 215      AR3, CPI 215
398  001 170  312 165 001  JTZ LUUP2
399  001 173  376 233      CPI 233
400  001 175  312 046 341  JTZ MONITOR
401  001 200               /
402  001 200  171          AR4, LAC
403  001 201  027          RAL
404  001 202  027          RAL
405  001 203  027          RAL
406  001 204  346 370      NDI 370
407  001 206  117          LCA
408  001 207  333 021      INP 21
409  001 211  366 200      ORI 200
410  001 213  326 260      SUI :0
411  001 215  332 024 000  JTC START
412  001 220  376 010      CPI 8D
413  001 222  322 024 000  JFC START
414  001 225  201          ADC
415  001 226  117          LCA
416  001 227  303 143 001  JMP LUP2
417  001 232               /
418  001 232               /
419  001 232               /THE 'ERROR' ROUTINE PRINTS OUT
420  001 232               /THAT THERE HAS BEEN AN ERROR
421  001 232               /AT THE ADDRESS IN THE H&L REGISTERS
422  001 232               /IT THEN TELLS THAT THE TEST BYTE
423  001 232               /IS THE BYTE IN THE ACCUMULATOR
424  001 232               /AND THE ERROR BYTE IS THE BYTE
425  001 232               /POINTED TO BY THE H&L REGISTERS
426  001 232               /FINALY IT PRINTS OUT THE BITS
427  001 232               /THAT ARE IN DISSAGREEMENT IN THE
428  001 232               /TWO BYTES.
429  001 232               /
430  001 232  371          ERROR, SPHL
431  001 233  041 245 001  LXH ER1
432  001 236  127          LDA
433  001 237  001 234 002  LXB MSG4
434  001 242  303 026 001  JMP MSGOUT
435  001 245               /
436  001 245  041 000 000  ER1, LXH 0 0
437  001 250  071          DADS
438  001 251  102          LBD
439  001 252  353          XCHG
440  001 253  041 261 001  LXH ER2
441  001 256  303 034 002  JMP OUTER
442  001 261               /
443  001 261  123          ER2, LDE
444  001 262  041 270 001  LXH ER3
445  001 265  303 034 002  JMP OUTER
446  001 270               /
447  001 270  120          ER3, LDB
448  001 271  001 263 002  LXB MSG5
449  001 274  041 302 001  LXH ER4
450  001 277  303 026 001  JMP MSGOUT
451  001 302               /
452  001 302  041 310 001  ER4, LXH ER5
453  001 305  303 034 002  JMP OUTER
454  001 310               /
455  001 310  001 310 002  ER5, LXB MSG6
456  001 313  041 321 001  LXH ER6
457  001 316  303 026 001  JMP MSGOUT
458  001 321               /
459  001 321  041 000 000  ER6, LXH 0 0
460  001 324  071          DADS
461  001 325  132          LED
462  001 326  126          LDM
463  001 327  041 335 001  LXH ER7
464  001 332  303 034 002  JMP OUTER
465  001 335               /
466  001 335  001 335 002  ER7, LXB MSG7
467  001 340  041 346 001  LXH ER8
468  001 343  303 026 001  JMP MSGOUT
469  001 346               /
470  001 346  026 000      ER8, LDI 0
471  001 350  006 001      LBI 1
472  001 352  041 000 000  LXH 0 0
473  001 355  071          DADS
474  001 356  173          LAE
475  001 357  256          XRM
476  001 360  137          LEA
477  001 361               /
478  001 361  024          LOP, IND
479  001 362  173          LAE
480  001 363  037          RAR
```

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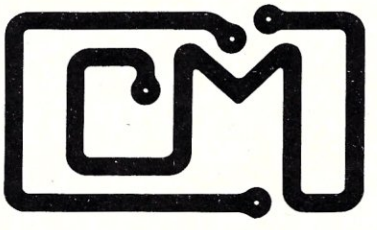
Circle Number 63 on Reader Service Card



THE BEST BYTE IN THE BIG APPLE

When you come to New York City (as everyone does sooner or later) visit the Computer Mart and see the largest exhibit of up-and-running computers, terminals, boards and software. Ask questions of people who know what they are talking about. Bring money. You will want to buy all the things you have read about in the magazines when you hear our low prices.

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Circle Number 64 on Reader Service Card

```
481  001 364  137           LEA
482  001 365  322 023 002   JFC NOERR
483  001 370               /
484  001 370  005           DCB
485  001 371  312 007 002   JTZ LOPE
486  001 374  333 020       LUPE, INP 20
487  001 376  346 002       NDI 2
488  002 000  312 374 001   JTZ LUPE
489  002 003  076 254       LAI 254
490  002 005  323 021       OUT 21
491  002 007               /
492  002 007  333 020       LOPE, INP 20
493  002 011  346 002       NDI 2
494  002 013  312 007 002   JTZ LOPE
495  002 016  172           LAD
496  002 017  306 257       ADI 257
497  002 021  323 021       OUT 21
498  002 023               /
499  002 023  172           NOERR, LAD
500  002 024  376 010       CPI 8D
501  002 026  302 361 001   JFZ LOP
502  002 031  303 024 000   JMP START
503  002 034               /
504  002 034  333 020       OUTER, INP 20
505  002 036  346 002       NDI 2
506  002 040  312 034 002   JTZ OUTER
507  002 043               /
508  002 043  076 240       LAI 240
509  002 045  323 021       OUT 21
510  002 047  333 020       OUTR2, INP 20
511  002 051  346 002       NDI 2
512  002 053  312 047 002   JTZ OUTR2
513  002 056               /
514  002 056  172           LAD
515  002 057  007           RLC
516  002 060  007           RLC
517  002 061  346 003       NDI 3
518  002 063  306 260       ADI :0
519  002 065  323 021       OUT 21
520  002 067               /
521  002 067  333 020       OUTR3, INP 20
522  002 071  346 002       NDI 2
523  002 073  312 067 002   JTZ OUTR3
524  002 076  172           LAD
525  002 077  017           RRC
526  002 100  017           RRC
527  002 101  017           RRC
528  002 102  346 007       NDI 7
529  002 104  306 260       ADI :0
530  002 106  323 021       OUT 21
531  002 110               /
532  002 110  333 020       OUTR4, INP 20
533  002 112  346 002       NDI 2
534  002 114  312 110 002   JTZ OUTR4
535  002 117  172           LAD
536  002 120  346 007       NDI 7
537  002 122  306 260       ADI :0
538  002 124  323 021       OUT 21
539  002 126  333 021       INP 21
540  002 130  376 233       CPI 233
541  002 132  312 046 341   JTZ MONITOR
542  002 135  351           PCHL
543  002 136               /
544  002 136               /
545  002 136               /MESSAGE TABLE
546  002 136               /
547  002 136               /THIS TABLE CONTAINS THE PROMPT
548  002 136               /MESSAGES USED BY THE PROGRAM
549  002 136               /
550  002 136  223           MSG0, 223
551  002 137  226           226
552  002 140  240           240
553  002 141  240           240
554  002 142  240           240
555  002 143  240           240
556  002 144  222           222
557  002 145  222           222
558  002 146  222           222
559  002 147  222           222
560  002 150  000           0
561  002 151               /
562  002 151  215           MSG1, 215
563  002 152  212           212
564  002 153  215           215
565  002 154  212           212
566  002 155  240           240
567  002 156  323           :S
568  002 157  324           :T
569  002 160  301           :A
570  002 161  322           :R
571  002 162  324           :T
572  002 163  311           :I
573  002 164  316           :N
574  002 165  307           :G
575  002 166  240           240
576  002 167  301           :A
577  002 170  304           :D
578  002 171  304           :D
579  002 172  322           :R
580  002 173  305           :E
581  002 174  323           :S
582  002 175  323           :S
583  002 176  277           :?
584  002 177  240           240
585  002 200  000           0
586  002 201               /
587  002 201  215           MSG2, 215
588  002 202  212           212
589  002 203  240           240
590  002 204  240           240
591  002 205  240           240
592  002 206  305           :E
593  002 207  316           :N
594  002 210  304           :D
595  002 211  311           :I
596  002 212  316           :N
597  002 213  307           :G
598  002 214  240           240
599  002 215  301           :A
600  002 216  304           :D
601  002 217  304           :D
602  002 220  322           :R
603  002 221  305           :E
604  002 222  323           :S
605  002 223  323           :S
606  002 224  277           :?
607  002 225  240           240
608  002 226  000           0
609  002 227               /
610  002 227  215           MSG3, 215
611  002 230  212           212
612  002 231  317           :O
613  002 232  313           :K
614  002 233  000           0
615  002 234               /
616  002 234  215           MSG4, 215
617  002 235  212           212
618  002 236  215           215
619  002 237  212           212
620  002 240  240           240
621  002 241  240           240
622  002 242  240           240
623  002 243  240           240
624  002 244  305           :E
625  002 245  322           :R
626  002 246  322           :R
627  002 247  317           :O
628  002 250  322           :R
629  002 251  240           240
630  002 252  301           :A
631  002 253  324           :T
632  002 254  240           240
633  002 255  302           :B
634  002 256  331           :Y
635  002 257  324           :T
636  002 260  305           :E
637  002 261  243           :#
638  002 262  000           0
639  002 263               /
640  002 263  215           MSG5, 215
641  002 264  212           212
642  002 265  240           240
643  002 266  240           240
644  002 267  240           240
645  002 270  240           240
646  002 271  324           :T
647  002 272  305           :E
648  002 273  323           :S
649  002 274  324           :T
650  002 275  240           240
651  002 276  302           :B
652  002 277  331           :Y
653  002 300  324           :T
654  002 301  305           :E
655  002 302  240           240
656  002 303  327           :W
657  002 304  301           :A
658  002 305  323           :S
659  002 306  272           :#
660  002 307  000           0
661  002 310               /
662  002 310  215           MSG6, 215
663  002 311  212           212
664  002 312  240           240
665  002 313  240           240
666  002 314  240           240
667  002 315  305           :E
668  002 316  322           :R
669  002 317  322           :R
670  002 320  317           :O
671  002 321  322           :R
672  002 322  240           240
673  002 323  302           :B
674  002 324  331           :Y
675  002 325  324           :T
676  002 326  305           :E
677  002 327  240           240
678  002 330  327           :W
679  002 331  301           :A
680  002 332  323           :S
681  002 333  272           :#
682  002 334  000           0
683  002 335               /
684  002 335  215           MSG7, 215
685  002 336  212           212
686  002 337  302           :B
687  002 340  311           :I
688  002 341  324           :T
689  002 342  323           :S
690  002 343  240           240
691  002 344  311           :I
692  002 345  316           :N
693  002 346  240           240
694  002 347  305           :E
695  002 350  322           :R
696  002 351  322           :R
697  002 352  317           :O
698  002 353  322           :R
699  002 354  240           240
700  002 355  301           :A
701  002 356  322           :R
702  002 357  305           :E
703  002 360  272           :#
704  002 361  240           240
705  002 362  000           0
706  002 363               /
707  002 363               /THIS IS WHERE MY MONITOR ROUTINE
708  002 363               /RESIDES.  IF I PRESS "ESCAPE"
709  002 363               /THEN THE PROGRAM WILL RETURN
710  002 363               /ME TO MY MONITOR
711  002 363               /
712  002 363               ORG 341 046
713  341 046               MONITOR, STR 0
714  341 046               /
715  341 046               END
716  341 046
```

```
BEGIN     000 000
START     000 024
MSG0      002 136
MSGOUT    001 026
ST1       000 035
MSG1      002 151
ST2       000 043
INOCT     001 052
ST3       000 056
MSG2      002 201
ST4       000 064
LOOP1     000 072
DONE1     000 144
CHECK     000 165
ERROR     001 232
LOOP2     000 204
DONE2     000 274
LOOP3     000 315
LOOP4     000 334
ST5       001 020
MSG3      002 227
AR1       001 034
LUP1      001 055
LUP2      001 143
MONITOR   341 046
LUUP2     001 165
AR3       001 166
AR4       001 200
ER1       001 245
MSG4      002 234
ER2       001 261
OUTER     002 034
ER3       001 270
MSG5      002 263
ER4       001 302
ER5       001 310
MSG6      002 310
ER6       001 321
ER7       001 335
MSG7      002 335
ER8       001 346
LOP       001 361
NOERR     002 023
LOPE      002 007
LUPE      001 374
OUTR2     002 047
OUTR3     002 067
OUTR4     002 110
```

Perspective in Electronics revolution

The March 18, 1977 issue of *Science* magazine was devoted exclusively to the "electronics revolution". It contains 28 excellent articles in five broad categories: Introduction to the Continuing Revolution, The Pervasiveness of Electronics (applications), Policy Problems, Computers and People, and Research Frontiers.

It would be hard to imagine a better way for the hobbyist, or even the professional computer scientist to get a meaty, but high level perspective on electronics and computers, then by reading this magazine from cover to cover. Without exception, the articles are pertinent and well written, and the reader is introduced to the thinking of many of the leading scientists in the field. They cover topics from the broadest issues of social impact to surveys of specific research, and it all hangs together.

Two figures taken from the issue illustrate the perspective provided. The first, taken from the article "Intellectual and Economic Fuel for the Electronics Revolution" by John G. Linvill and C. Lester Hogan, shows how far we have come since ENIAC. The second, taken from "The Impact of Integrated Electronics in Medicine" by Robert L. White and James D. Meindl, indicates where we may be headed.

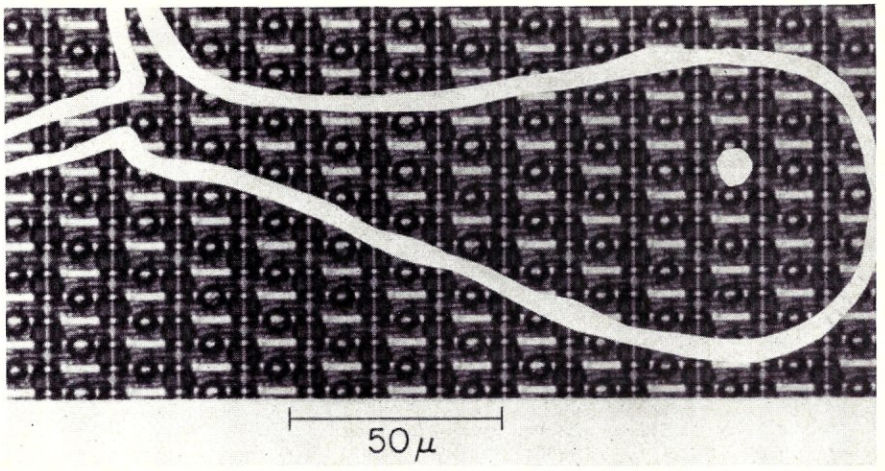
Copies of this issue are available for $3.00 from: Corrine Harris, Back Issues Dept., American Association for the Advancement of Science, 1515 Massachusetts Avenue, NW, Washington, D.C. 20005.

The September issue of *Scientific American* will also be devoted to electronics. Why don't one of you review it for us?

The sensory robots are near,
but will not be ready this year.
for each of them tries
to eat with his eyes,
and cocks his nose trying to hear.

Gloria Maxson

Science Review



Looking to the future, a photomicrograph of semiconductor memory chip with image of cerebral neuron superimposed. The bar represents 50 μm.

Dozens of active semiconductor elements fit within the area of the cell body. The two-dimensional density of semiconductor memory or logic elements of advanced but current design is more than an order of magnitude higher than the corresponding density of cerebral nervous tissue. Even allowing for less efficient packing in the third dimension, it is now possible to attain a volume density of integrated circuit logic elements which is comparable to that of natural nervous tissue and to execute logical functions of similar complexity at similar energy cost. It is now technologically feasible to replace defective nervous tissue with synthetic neural circuits of similar size and power needs; the implied possibilities for prostheses are countless.

Looking back, a comparison of parameters of ENIAC with the Fairchild 8 (F8) microprocessor. Abbreviations: CPU, central processing unit; TTY, teletype terminal; ROM, read only memory; RAM, random access memory.

Item	Parameter	ENIAC	F8*	Comments
1	Size	3,000 cubic feet	0.011 cubic feet	300,000 times smaller
2	Power consumption	140 kilowatts	2.5 watts	56,000 times less power
3	ROM	16K bits (relays and switches)	16K bits	Equal amount
4	RAM	1K bits (flip-flop accumulators)	8K bits	Eight times more RAM in F8
5	Clock rate	100 kilohertz	2 megahertz	20 times faster clock rate with F8
6	Transistors or tubes	18,000 tubes	20,000 transistors	About the same
7	Resistors	70,000	None	F8 uses active devices as resistors
8	Capacitors	10,000	2	5,000 times less
9	Relays and switches	7,500	None	
10	Add time	200 μsec (12 digits)	150 μsec (8 digits)	About the same
11	Mean time to failure	Hours	Years	More than 10,000 times as reliable
12	Weight	30 tons	< 1 pound	

*For comparison in this table, the F8 microcomputer is assumed to consist of one 3850-CPU, one 3856-PSU (2K bytes of ROM), eight 1K RAM packages, and the static memory interface chip 3853, plus teletype terminal interface circuitry.

SCCS Member Discount Plan

The Board voted to implement the membership discount plan proposed in Gene Murrow's article in the February *Interface*. The following vendors have sent in discount offers, and we hope to hear from more soon.

Vendor	Item	List	Member Price	Delivery* Options
Computer Power and Light 12331 Ventura Blvd. Studio City, CA 91604	Novation acoustic modem COMPAL-80 16k computer with terminal COMPAL ASR 33 keyboard Sanyo VM 4092 9" monitor	295 2300 165 185	236 2070 125 160	LA Meeting C,V
AAAA Computer Hows 1477 Barrington, suite 17 Los Angeles, CA 90025	IMSAI I-8080 (22 slots) IMSAI boards Polymorphic Poly-88 system 2 PolyMorphic boards Seals 8K-KSC-z memory Other Seals products	751 10% discount 735 10% discount 295 10% discount	638 610 265 	LA Meeting C,V
Tarbell Electronics 20620 S. Leapwood Ave., suite P Carson, CA	Tarbell Cassette, kit Tarbell Cassette, assembled	120 175	108 157	LA Meeting C,V
The Computer Store 820 Broadway Santa Monica, CA 90401	VTL in ROM for 680 or 8080	114	99	LA Meeting C,V

*C = COD postage, V = pickup at vendors location.

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Name _____ List date _____

_____ membership number _____

_____ Phone number _____

Address _____

Item	Vendor name	Delivery option

I understand that the terms of this order are COD and that if I am to pick up any items, I shall do so within 30-60 days of publication of this form.

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A short tutorial on the PRINT USING statement in BASIC. A number of examples are included. The article is by Gene Dial and it appeared in *Interrupt* from the Denver Amateur Computer Society. SASE + 20¢

8080 OS
Paper design for EMOS-8, an Extensible Microcomputer Operating System for the 8080. Memory use, multitasking and interrupts, entity naming, I/O, VDM, editing, loading, assembling, debugging and standardization are covered. Bob Wallace, the author, invites feedback and the design is in the public domain. Implementation is beginning. SASE + 70¢

Pennywhistle Evaluation
A brief review of the Pennywhistle Modem, by William E. Fisher, Jr., which appeared in the Pittsburgh area Computer Club Newsletter. William likes the Pennywhistle and M & R Enterprises from whom he purchased it. SASE + 10¢

8080 Language
Specifications of EMUL-8, an Extensible Microcomputer Users Language for the 8080. This was also written by Bob Wallace of the Northeast Computer Club. SASE + 40¢

Cybercom VB1 Fix
A fix for unstable vertical output on the Cybercom VB1. By John Schulein in the Homebrew Computer Club Newsletter.

Recorder Mods
Modifications for the J. C. Penney Co. 6536 and 6551 Tape Recorders which are recommended by Tarbell. Keep the speaker on and the mike off. By Lorin Mohler, North Orange County Computer Club. SASE + 30¢

IMSAI Fixes
Half a dozen quick, miscellaneous fixes for IMSAI's by Leon Rue of the North Orange County Computer Club. SASE + 10¢

Lunar Lander
A lunar lander in Tom Pittman's Tiny BASIC, written by David G. Krauss in the Homebrew Computer Club Newsletter. SASE + 20¢

Phone Detector
Mike Firth showed a simple circuit to detect the ringing of a telephone in the June issue of the Newsletter of the Computer Hobbyist Group of North Texas. SASE + 10¢

Proposed S-100 Bus Standards
Joe Killian of IMSAI presents a proposed standard set of equations for use in decoding S-100 bus operations. SASE + 20¢

Games and Things...

Great Moments in Pi

By Phil Feldman and Tom Rugg, Associate Editors

One of the first geometric insights of civilized man was the realization that the ratio of the circumference of any circle to its diameter is a constant. This constant came to be denoted by the Greek letter pi—(π). It appears frequently in mathematical formulas. Computing its value, however, is no simple task. The onset of electronic digital computers helped verify previous work and carry the calculation to new heights of precision. Man's attempts to compute pi are a great testimonial to his ingenuity and persistence.

• • • • •

A search though the Bible reveals that the ancient Babylonians and Hebrews apparently considered pi to be 3. There are two distinct Old Testament references to perfectly round objects described as "10 cubits across" and "30 cubits around." In Egypt around 1500 B.C. the value used for pi was $(16/9)^2$ which is about 3.1605.

A True Pi-oneer

This sad state of affairs was to last about 1000 years. Archimedes made the first major breakthrough in calculating pi about 240 B.C. The Greeks knew how to compute the area of figures bounded by straight lines by breaking them into triangles. They also knew that the area of a circle equals pi times the square of the radius of the circle. If only the area of a circle of known radius could be computed, a value for pi could be found. Archimedes considered the areas of various polygons inscribed in a circle. Each polygon had a main diameter equal to the diameter of the circle. As the number of sides of the polygon increased, the polygon came closer and closer to looking like the circle. By carrying his work out to a 96 sided polygon and also considering polygons circumscribed on the circle, Archimedes was able to pin down the value of pi between $3^{10}/_{70}$ and $3^{10}/_{71}$ or 3.14084 . . . and 3.14285 . . . Truly a remarkable achievement accomplished without even a pocket calculator! (Batteries were hard to come by in Ancient Greece.)

The Chinese Method

A considerable advance was made next from halfway around the world. A Chinese irrigation engineer named Tsu Ch'ung chih computed pi to be between 3.1415926 and 3.1415927 around A.D. 480. Exactly how he

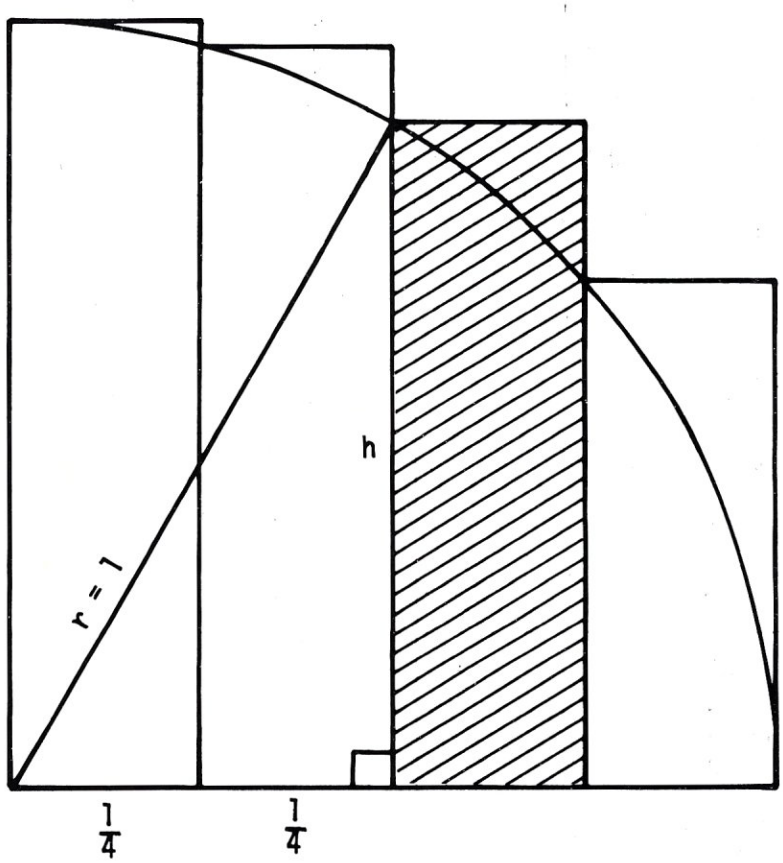


Figure 1. The Chinese Method

accomplished his feat is not known. However, it is believed he used a geometric method which was "discovered" in Europe over 1000 years later.

Again, the area of a circle of known radius will be computed so that pi can be calculated by dividing that area by the radius squared. If the radius is taken to be one, then pi will equal the area of the circle. The method consists of breaking the circle up into several tiny rectangles. See Figure 1, which shows one quadrant of this circle broken into 4 rectangles. The short base of each rectangle is 1/4. The height of each rectangle can be computed directly from Pythagorean theorem for right triangles. For example, the shaded rectangle has a height h, such that $h^2 + (1/2)^2 = 1^2$. From this formula, h can be computed. Thus we can compute the area of each rectangle. Now we add up these areas and we have an approximation for the area of one quadrant of this circle with a radius of 1. Multiplying this area by 4 gives a value for the area of the whole circle and thus a value of pi.

Gradually, the circle is broken into more and more, but thinner and thinner, rectangles. Thus the area of the rectangles gets closer and closer to the area of the circle. Clearly the rectangles will always have an area greater than that of the circle. By also taking "inside" rectangles, we can get closer and closer to pi with areas that are less than that of the circle.

In Figure 2, a program is presented to do this calculation for various numbers of rectangles. The sums of the "inner" and "outer" rectangles are presented separately along with the current estimate of pi which is taken as the average of the two areas. At each step, N is the number of rectangles. The variable I contains the "inner" sum and W contains the "outer" sum. The code was written in MITS Basic. The output table took about 5 minutes to compute on an Altair 8800b. A loop from 1 to N must be computed for each line of output. Since the number of rectangles increases by powers of 2, each line took about as much time to compute as all the previous lines combined. The reader may enjoy showing that the program does indeed do the calculation outlined above.

```
10 REM CHINESE PI CALCULATOR — A.D. 480 AND AUG. 1977
20 REM WRITTEN BY PHIL FELDMAN, TOM RUGG AND TSU CH'UNG CHIH
30 PRINT "NO. RECT.","INNER AREA","OUTER AREA","PI":N=1
40 N=2*N:N2=N*N:S=0:FOR J=1 TO N
50 S=S+SQR(N2-J*J):NEXT:I=4*S/N2
60 W=I+4/N:P=(I+W)/2:PRINT N,I,W,P:GOTO 40
```

NO. RECT.	INNER AREA	OUTER AREA	PI
2	1.73205	3.73205	2.73205
4	2.49571	3.49571	2.99571
8	2.83982	3.33982	3.08982
16	2.99825	3.24825	3.12325
32	3.0726	3.1976	3.1351
64	3.10805	3.17055	3.1393
128	3.12516	3.15641	3.14078
256	3.1335	3.14912	3.14131
512	3.13759	3.1454	3.14149
1024	3.1396	3.14351	3.14156
2048	3.1406	3.14256	3.14158

Figure 2. Program and Output

The Continental Scene

During the Dark Ages and Middle Ages, there is not much to report on further calculations of pi. However, by the time of the Renaissance, things picked up again. In the early 1590's Francisco Vieta calculated pi to 10 significant digits placing its value between 3.1415926535 and 3.1415926537. This precision is good enough to give the circumference of the earth within a fraction of an inch (assuming the radius of the earth is known to this precision). Vieta obtained this value by a procedure similar to that of Archimedes. Vieta worked out the limits from a polygon of 393,216 sides!

Vieta was not to keep the limelight long. Ludolph van Ceulen, a German mathematician, was determined to break Vieta's record in a blaze of glory. Working on his project most of the last half of this life, he calculated pi to 35 digits in 1596! When he died at age 70, he requested that his 35 digits be inscribed as a fitting epitaph on his tombstone. Indeed, they were!

The mid 1600's saw a couple of clever fellows come along named Sir Isaac Newton and Gottfried Wilhelm von Liebnitz. With their invention of the calculus, a new tool was developed for computing pi. Infinite mathematical series could be developed which converged to pi in the limit. Successive terms in these series were smaller and smaller and thus, with patience, a straightforward method was available to compute pi to any accuracy desired. No longer would geometric methods be used. Their discoveries would revolutionize the search for pi.

Same Time, Same Channel

Sorry to leave you on the edge of your seats, but next month we will continue the saga from here. Those burning questions on your lips will be answered: Why does pi have infinitely many "unpredictable" digits? How do digital computers enter the picture? Why calculate so many digits of pi anyhow? And make your guesses before next month—what do you think is the one millionth decimal digit of pi?

Reviews, Pointers 'n' Such

Ron Carlson, Editor

One of the most commonly asked questions I hear from readers is: "Where can I find a book on . . .?" Hopefully the first part of that is answered here. But the second part, "Where can a copy be found?" can be elusive. If you are affluent and want to buy a copy, the most responsive sources are: university bookstores, college or j.c. bookstores, technical bookstores, publishers, local bookstores, or a bookfinder service. Assuming you are on a limited budget, try these: university libraries, college or j.c. libraries, large public libraries, university departmental libraries, large corporation's libraries, club libraries, friends, or the Christmas list.

Rating Code

CONTENT:

Beginner	B
Moderate	M
Advanced	A

BITS/BUCK

O.K.	O
Good	G
Excellent	E
Steep, but good	S

USEFULNESS

Classic	C
Text level	T
Handy	H

Bibliography

(Continued from August)

Assemblers

C2) **Assemblers and Loaders** D. Barrow 1970 American Elsevier 60pp $9.25 BMET

C3) **An Introduction to Macros** M. Campbell-Kelly American Elsevier 120pp $8.50 BMGH

Languages

L3) **PASCAL, User Manual & report** K. Jensen & N. Wirth 1975 Springer-Verlag 165pp $5.90 BMAETH

L4) **GPS: A Case Study in Generality & Problem Solving** G. Ernst & A. Newall 1969 Academic Press 294pp $22.75 MAESC

L5) **The General Inquirer: A Computer Approach to Content Analysis** P. Stone, et al 1966 MIT Press $9.95 MAEC

Games

A7) **Game Playing with Computers 2nd Ed.** D. Spencer 1975 Hayden 312pp $17.95 BGH

Compilers, Interpreters

B4) **Principles of Compiler Design** A. Aho & J. Ullman 1977 Addison Wesley 591pp $18.95 BMET

B5) **Compiling Techniques** F. Hopgood 1970 American Elsevier 123pp $6.95 BMGT

B6) **A Compiler Generator** W. McKeeman, et al 1970 Prentice-Hall 527pp $19.95 MGT

B7) **A Syntax-Oriented Translator** P. Ingerman 1966 Academic Press 125pp $5.95 MET

B8) **Design and Optimization of Compilers** R. Rustin, Ed. 1972 Prentice-Hall 141pp $10.50 AGT

B9) **The Theory of Parsing, Translation, and Compiling Vol I: Parsing** A. Aho & J. Ullman 1972 Prentice-Hall 542pp $18.50 BMAET

B10) **The Theory of Parsing, Translation, and Compiling Vol II: Compiling** A. Aho & J. Ullman 1973 Prentice-Hall 460pp $17.95 BMAET (section on code generation)

B11) **Compiler Construction** G. Goos & J. Hartmanis 1976 Springer-Verlag 638pp $17.30 AET (xlnt. chptrs. on code generation)

B12) **The Anatomy of a Compiler 2nd Ed.** J. Lee 1974 Van Nostrand Reinhold 464pp $11.95 BMOT

Graphics

D1) **Principles of Interactive Graphics 2nd Ed.** W. Newman & R. Sproull 1973 Mc Graw-Hill 599pp $13.50 BMAETH (has the hidden line algorithm!)

Computer Science

N2) **Naive Set Theory** P. Halmos 1970 Springer-Verlag 102pp $7.90 BMET (The best book on set theory I've ever seen)

N3) **Computer Structure: Readings & Examples** C. Bell & A. Newall 1971 McGraw-Hill 651pp $18.50 BMSTC

Robotics

01) **On Machine Intelligence** D. Michie 1974 Edinburgh Univ. Press 199pp $6.95 BGC

02) **On the Theory and Practice of Robots and Manipulators Vols I & II** First CISM-IFToMM Symposium in Udine, Italy 1974 Springer-Verlag 665pp $44.00 for both Vols AESC (A gold mine of a book)

03) **Build Your Own Working Robot** D. Heiserman 1976 Tab Books 228pp $5.95 BGH

04) **The Minds of Robots; Senses, Memory, & Behavior in Conscious Automata** J. Culbertson 1963 Univ of Illinois Press 453pp $10.00 MET

Artificial Intelligence

P1) **Perceptrons** M. Minsky & S. Papert 1969 2nd prtg. MIT Press 253pp $6.95 MAEC

P2) **Introduction to Artificial Intelligence** P. Jackson 1974 Mason & Lipscomb 445pp $18.50 BGT

P3) **Modeling of Thinking and the Mind** M. Amosov 1967 Spartan Books 187pp $13.80 BMGT

P4) **Computer Augmentation of Human Reason** M. Saos & W. Wilkinson, Eds. 1965 Spartan Books 231pp $10.00 BMOH (has good 43pp biblio.)

P5) **Computer Models of Personality** J. Lochlin 1968 Random House 165pp $2.95 BMGH

P6) **The Computer Simulation of Behavior** M. Apter 1971 Harper Colophon 172pp $2.25 BGH

P7) **Artificial Intelligence Through Simulated Evolution** L. Fogel, et al 1966 John Wiley 165pp $9.95 MAEC (minor classic)

Varied Interests

S1) **Cryptanalysis** H. Gaines 1939 Dover (paper) $3.00 BMAETCH

S2) **Video Game Logic Vol I** 1976 Kush N' Stuff Amusement Electron-

ics, 60 Dillon Ave. Campbell CA 111pp $14.95 BMASTH

Journals, Mags.

U1) **Artificial Intelligence, an International Journal** Quarterly North-Holland $36/yr AEC

Science Fiction

Y1) **Second Ending** J. White 1962 Ace Double -F-173 $.40-$2.00 @ used book stores 100pp G (robots)

Y2) **Computer War** M. Reynolds 1967 Ace Double H-34 111pp $.60 G (basis for an ultimate computer game)

Y3) **Star Wars** G. Lucas 1976 Ballantine 220pp $1.50 GC

MODU-LEARN
Microcomputer Software Course

T. Barry, assisted by the publishers staff (T4)
reviewed by Tiny Matthews

I have received literature from people who wanted to sell me all there was to know about programming micros for a hundred dollars. I actually started at it with a $19.95 book. Since the MODU-LEARN comes somewhere near the middle of the range, it is worth a closer look. It is a single, two-inch thick loose-leaf collection which is divided into three main parts.

First is a "Background Section" which is described as "an overview of computer fundamentals". It could well serve by itself as a text for a course in computer fundamentals, and contains more practical information than many books published for that purpose. For example, the discussions of differing architectures and addressing schemes go beyond simple descriptions, and point out the impacts that these factors can have on your programming. The software portion of the "overview" displays the same attention to practicality.

The second part is the real meat of the course-programming. It is very well developed in a smoothly progressive manner. The author is slightly hung up on structured programming (in the "TDSP" sense) but does not worship it with the blind fanaticism that most advocates of the technique display. An extremely unusual technique is the use of a real micro as the example computer, instead of a simplified machine which exists only on paper. The 8080 is used as the demonstrator, but this should not discourage you 6XXX fans, since the reality of the examples does not detract from the generality of the discussion. It just gives it a little more realism. For you TDSP cultists, there are some interesting ideas on implementing the magic structures in assembly level work.

The final part is a reference section. It has the usual glossary, rather more than usual code and number conversion tables, and some good words about assemblers.

It is impossible to really detail a document this large in a review. I can only suggest that if you are in the market for a comprehensive text to help you tame the beast on your desk, you should try to look at a copy of this one. The price is pretty steep, but it is well done, and contains more "real" information than any other single book I have read. They want me to send it back, and I am going to be sorry to part with it.

Game Playing With Computers 2nd Edition

D. Spencer (A7)
Reviewed by Ron Carlson

This second edition is a welcome sight after the 1968 first edition. This one has some real substance to it. A quick scan through the table of contents shows chapters on magic squares, primes, puzzles, casino games, board games, number games, unusual gambling games, game playing with BASIC, betting systems, random numbers, exercises, and a bibliography. But of prime value in this book are the three chapters on magic squares (105 pp!), the 15 and 34 puzzle, and primes. You remember the 15 puzzle — it was that little plastic square with the sliding numbers you found in the "days-of-the-long-vacation-eat-this-and-be-good-backseat-Cracker-Jack-box." I found mine somewhat before my formal introduction to al-Khowarizmi ("Who's that?" you say? See Chapter 1). The author gives a nice introduction to the puzzle and its history along with a program to prove the existence of various types of solutions, but sadly, not the solutions themselves. Oh well, as best I remember my first solution had some relation to my pen knife and some plastic shavings . . .

Primes are well presented with various methods for computing them and some algorithms for certain intervals. A lot of fun and tantalizing, but be sure your computer time is free!

By far the best chapters are on magic squares. From simple to complex this will really exercise your computer! There are many famous solutions and algorithms presented, but beware, the diligent explorer will soon find that there are some fundamental and important questions which arise that have yet to be answered.

The games of NIM and TIC TAC TOE are, as usual, given a thorough treatment. Good for beginners, but as one finds out, the algorithms are too simple to retain much interest. CHECKERS, GO, and CHESS are given a description and the book moves on to betting systems and random number generation algorithms.

The first edition's material is in FORTRAN "because of its increasingly widespread adoption". Chapter 12 recaps much of the material in BASIC to keep it current.

Easily read and just right for that first programming stab at games.

A privacy data lab keeps
unsavory secrets in heaps
    it cannot disclose,
    suggestive of prose
in diaries of Boswell and Pepys.

Gloria Maxson

Helpful Hints, or What I Had To Learn To Build a Computer

Tools

By Tricia Wood, Associate Editor

Many people wonder what kinds of tools are necessary for the construction of a hobby computer. The following is a list of what I have found to be the "basics" necessary for the construction and check-out of the printed circuit boards of the computer. Following the list is a description of each. I have also added some hints—"do's and don'ts" when it comes to putting the parts permanently on the boards.

1. Diagonal cutters
2. Pliers
3. Soldering tool
4. Clip leads
5. Volt-ohm meter
6. Wire strippers

1) Diagonal cutters—These are commonly known as "dikes". They cut wire and come in different sizes depending on what size wire you want to cut. This tool looks like a pair of pliers but the edges that meet are sharp for wire cutting.

2) Pliers—There are several different types of pliers that one can use. The first major consideration is whether they have "teeth" or not. The teeth prevent an object from slipping from the jaws. Pliers with smooth surfaces can't grip objects very well. I prefer those pliers with teeth. You also have a choice of the length of jaws. "Long-nose" pliers can get into small places, but shouldn't be used to really grab something. Pliers with shorter noses are heftier and can be used to pry and grab. Longer noses are usually thin and tend to break off when used in this manner. So analyze the job to be done and "pick your weapon".

3) Soldering tools—I talked about these in my article last month but here are some guidelines. There are soldering guns and soldering irons. Guns heat up instantaneously, but provide a lot of heat (more than is necessary for the tiny connections on a computer). They should be used for bigger jobs such as power connections on a power supply. There are many types of irons. You can choose a solder station that has a heat control to keep the iron at an even temperature. It also has a stand to hold the iron when not in use. Irons without constant heat control are available as well. A standard iron consists of a tip, a heater and a handle. These parts (all made by the same manufacturer) are interchangeable. I usually use a 42-45 watt heater with a small "chisel" tip. This enables me to get into small places on my boards.

4) Clip leads—These are insulated wires with clips at either end so that the wires can quickly be attached. These are a must when hooking up power temporarily or for last minute fixes. You should get several of them in assorted colors and sizes. Buy at least two different sized wires; thick for power supply usage and thin for general "board-to-board" connections.

5) Volt-ohm meter—This is an instrument for use in testing your circuits. The volt portion of the meter can be used to check voltage levels from your power supply or voltages from your board and outputs from and to chips. The ohm portion can be used to see if there is continuity between two given points. In other words, are the given points connected? The ohm meter can also be used to determine whether the resistors you use are good before you solder them to the board.

6) Wire strippers—These are used to cut the insulation from the wire, thereby leaving a bare conductor. There are many styles of strippers. There are simple types that can be adjusted for use with any gauge wire; and types that are fixed to use with only one wire size. I use the adjustable kind for purely economical reasons. It could be very expensive if one had to buy a pair of strippers for each size of wire he plans to use.

When the time arrives to put the parts on your boards there are a few hints you should keep in mind:

1) When putting resistor and capacitor leads into the holes, don't bend them over. Just solder them perpendicular to the board and trim closely (with dikes) after the soldering is done.

2) Don't overheat the boards. When soldering the parts to the pads on the boards, leave the iron on for only 3 seconds; if more soldering is required, wait a while and go back to that joint.

3) Make sure all parts to be soldered are clean and without corrosion. Use flux as a cleaning agent. After you are finished with the board, the flux can be removed with alcohol or a "flux solvent," which can be obtained at your favorite electronics shop.

4) Make sure all parts are on the same side of the board.

5) Go over the finished board with a magnifying glass to see if there are any "solder bridges" that could have formed.

Calendar

We go bananas each month putting together the Calendar section because we can't get current information on clubs, so we are going to try something new. We will publish the usual entries for large meetings and events and merely list contact numbers for local clubs. This time we will list the clubs from the last calendar. Let us know if you would like to add your club to the list. If you would like us to publish regular meeting announcements we will, but you must get them to us two months in advance.

(213) 849-7111	**San Fernando Valley**
(213) 849-7111	**San Fernando Valley Chapter**
(213) 822-8567	**Santa Monica, Bay Chapter**
(213) 681-7047	**Pasadena Chapter**
(213) 377-4811 Ext. 545	**South Bay Chapter**
(213) 598-0444	**SWTPCO Users Group**
(213) 681-7047	**LSI-11 Users Group**
(305) 452-2159	**Space Coast Microcomputer Club**
(612) 941-1051	**Minnesota Computer Society**
(703) 356-8918	**AMRAD, Vienna, VA**
(714) 998-5831	**North Orange County Computer Club**
(716) 889-2971	**Rochester Area Microcomputer Society**
(801) 467-9100	**Utah Computer Association**
(805) 985-2631	**Ventura County Computer Society**
(805) 962-7734	**Santa Barbara Computer Association**
(915) 697-4607	**Pesmian Basin Computer Group**

September 6-9

Compcon Fall '77

IEEE International Computer Society Conference at the Mayflower Hotel, Washington, D.C. For information, write Compcon Fall '77; Box 639; Silver Spring, MD 20901; or call (301) 439-7007.

September 17-18

Houston Personal Computing Faire

At the Hall of Exhibits, Shamrock Hilton Hotel, So. Main at Holcombe, Houston, TX. For information, write Houston Personal Computing Faire; P.O. Box 36584; Houston, TX 77036.

September 19-21

Wescon

Western Electronics Show and Convention in San Francisco, CA. For information, call them toll-free at (800) 421-6816.

September 24-25

New Orleans Hamfest/ Computerfest

Will be held at the Hilton Inn in Kenner, LA. Information on tickets, room reservations, etc., will be furnished upon request by contacting the New Orleans Hamfest/Computerfest; P.O. Box 10111; Jefferson, LA 70181.

September 26-28

International Electrical, Electronics Conference and Exhibition in Toronto.

For information, write them at 1450 Don Mills Rd; Don Mills, M3B 2X7, Canada

October 6-8

3rd International Conference on Very Large Data Bases, Tokyo, Japan

For information, write James Gabbert; MIT Sloan School; 50 Memorial Drive, Rm E53-330; Cambridge, MA 02139.

October 17-20

ISA/'77 – Instrument Society of America Conference and Exhibition

International Convention Center, Niagara Falls, N.Y. For information, write ISA; 400 Stanwix St; Pittsburgh, PA 15222, or call (412) 281-3171.

October 21

Deadline for NCC '78 Submissions

You are invited to participate in the 1978 National Computer Conference.

HOW TO PARTICIPATE IN NCC '78

1. Write a paper for review.
2. Prepare a demonstration of a new or valuable application.
3. Prepare a short talk for an open information exchange.
4. Send us your ideas on topics you would like to hear about at NCC '78.

Deadline for all submissions is October 21, 1977. Authors will be notified as soon as possible and no later than March 1, 1978 regarding acceptance. Please send your submissions to:

Mr. Stephen W. Miller
CONFERENCE CHAIRMAN
Stanford Research Institute
333 Ravenswood Ave., L 1109
Menlo Park, CA 94025

or

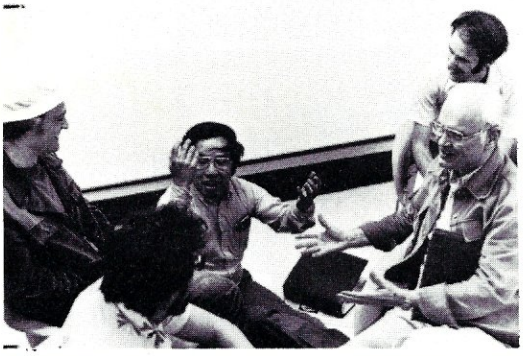
Dr. Leonard Y. Liu
PROGRAM CHAIRMAN
IBM Research Laboratory
K51/282
5600 Cottle Road
San Jose, CA 95193

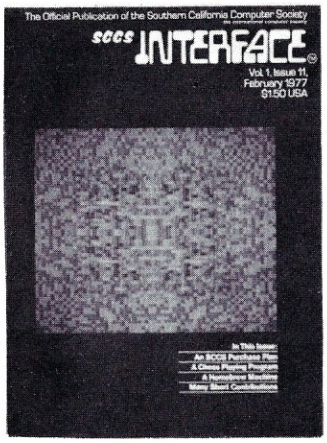
October 27, 28, 29

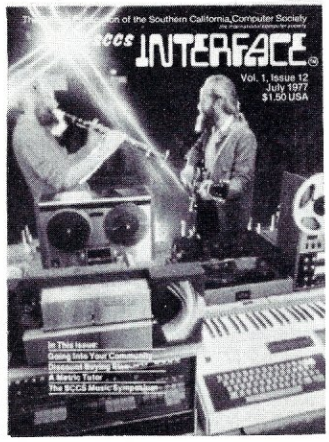
Midwest Personal Computing Show

Chicago, IL. Will be held at the Holiday Inn at O'Hare International Airport. For information, write Personal Computing Magazine; 401 Louisiana S.E., "G"; Albuquerque, NM 87108, or call (505) 255-8661.

Join the International Computer Society







5993 MEMBERSHIP APPLICATION

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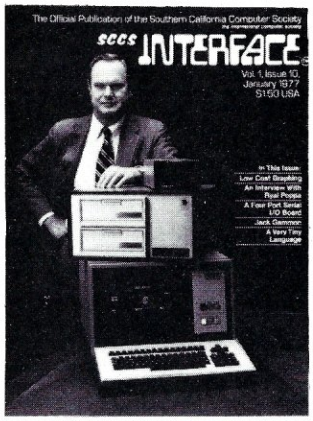

Your annual dues include a subscription to Interface, the official publication. Microcomputer (SCCS) Interface covers all aspects of microcomputing: applications, software and hardware. It features tutorial presentations (for beginners and to help break down the barriers between hardware and software people), how-to-do-it articles, and articles on more advanced theory and technique.

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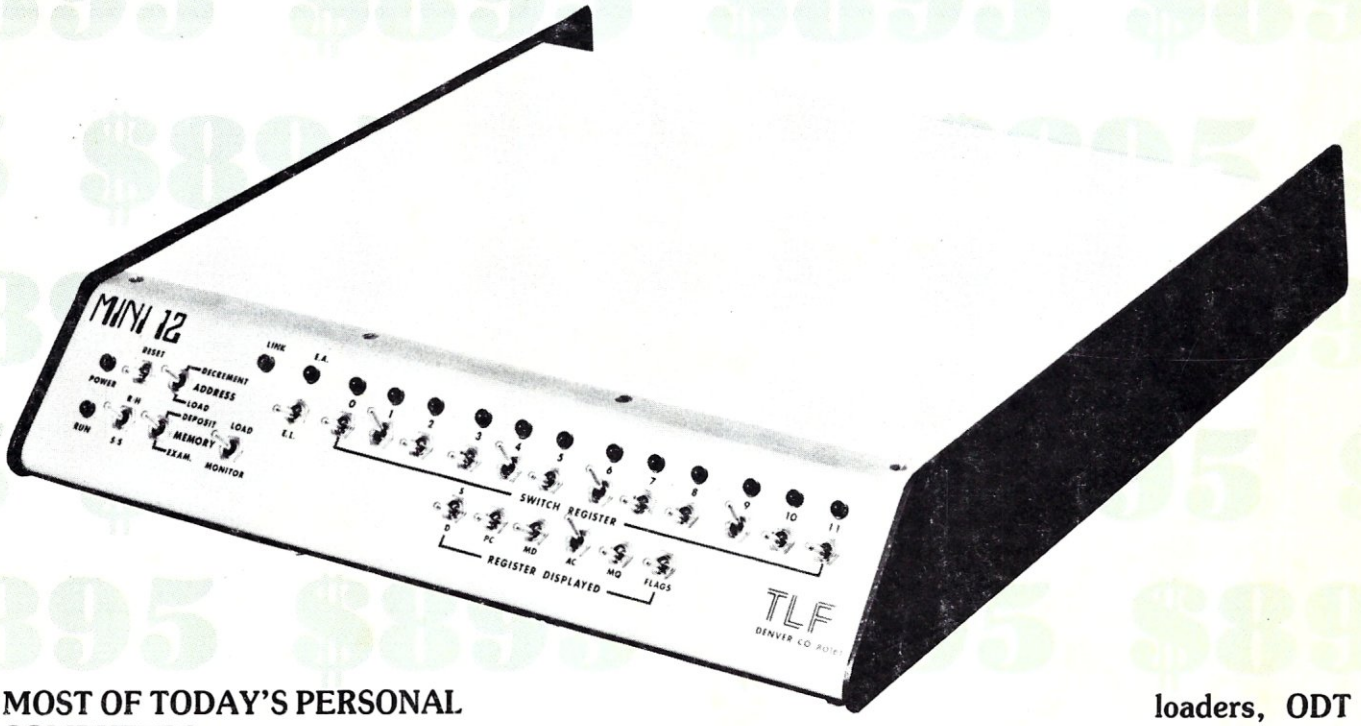

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